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ADAM'S GARDEN

The Cultivation of
Vegetables, Tomatoes, Rhubarb, and
Small Fruit

L. E. FOX

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THE CULTIVATION OF
VEGETABLES, TOMATOES, RHUBARB AND SMALL FRUIT

BY

L. E. FOX

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WITH A PREFATORY NOTE BY

F. J. CHITTENDEN

DIRECTOR
ROYAL HORTICULTURAL SOCIETY'S GARDENS
WISLEY

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PREFATORY NOTE

BY

F. J. CHITTENDEN

Director, Royal Horticultural Society's Gardens, Wisley

THIS little book is intended in the main for those whose gardening is a spare-time occupation, and for those who turn to gardening because of delight in growing things. That delight is common to nearly all of us when we are very young, but some lose it along with other graces of youth, and, maybe, never regain it. If it remains, then very often the pleasure is increased when reason and intellect can be brought into our work. It is good to know how to do a thing well; it is pleasant to get good results, but continued bad ones bring disappointment, and, perhaps, despair. To turn those bad ones into good by exercise of knowledge is often the most real pleasure of all.

Mr. L. E. Fox has endeavoured to show how good cultivation helps our plants. He has assumed that one knows how to dig—and shown why deep digging is good; and how to hoe—and shown why hoeing helps. Read with thought, it will readily be seen from this book why the garden line should be taut, and why, speaking generally, the best place for the dibber is hanging on a peg. He has given times and seasons for operations which are generally dependable, but has shown that soil and weather must overrule the calendar. In short, he has given us a book which will help us to see where we are apt to go astray, and which may be taken as a guide no matter where in Britain we may be, or how unlike an ideal "loam" the soil we have to deal with. And so I commend it to my fellow-gardeners.

FRED. J. CHITTENDEN.

ADAM'S GARDEN

To Adam, our father, his garden was a curse—a reminder of Paradise Lost. We, his inheritors, can make Adam's Garden a blessing—Paradise Regained. But for us, too, the times are hard. Success can be attained only by personal labour and personal knowledge. The ordinary professional advice available to most of us is hidebound by traditions—traditions of cheap labour, of cheap manure, of indifference to detail, of suspicion of change. Most of these traditions we cannot afford to maintain. Some must be perpetual, such as those of constant labour and of regular attention to gardens, but for the traditions that are out of date we must substitute personal acquaintance with the ways of the things we want to grow and with the modern aids that help them to grow. Our ideal, in fact, must be a garden of our own—not our gardener's—devoted only to our own selection of crops, each grown exactly as it should be. The smaller the garden the higher should be its standard of excellence.

In order to dispense with professional help and advice very precise information is required regarding soil, manure, and the detailed treatment of crops. This has not hitherto been available in a single book at a cheap price. An attempt is made in this book (at a price which brings it within the reach of all) to set forth clearly, precisely, fully, and conveniently all that need be known in order to grow good vegetables either with farm-yard manure or with artificial fertilizers. The arrangement of a garden and the selection of the things to grow in it are matters of local convenience and personal taste which are outside the scope of this book. It, in fact, attempts only a clear and simple statement of the points to which an allotment-holder or an owner-gardener must attend if he is to make himself independent of professional help and advice and yet to secure a very high standard of success from his own judgment and labour—a result not only of material profit but also of legitimate pride.

In this book the business of Adam, the bread-winner, is to raise vegetables and small fruit. If Madam, too, wants a garden, her privilege, obviously, is the cultivation of flowers, especially those useful in the adornment of the house. For this she will find an equally clear and simple guide in the companion volume, " Eve's Garden."

April, 1925.

CONTENTS

CHAPTER PARAS.
I. Physical Conditions 1–10
II. The Importance of Rotation and Manuring 11–12
III. Farm-yard Manure 13
IV. Objections brought against Artificial Fertilizers 14
V. Varieties and Properties of Artificial Fertilizers 15–29
VI. The Practical Application of Artificial Fertilizers 30–36
VII. Cultivation 37–52
VIII. Summary 53–55

Detailed Notes on

PAGE
Beetroot 58
The Common Characteristics of the Brassica Family 59
Broad Beans 61
Broccoli 62
Brussels Sprouts 63
Cabbages 63
Carrots 64
Cauliflowers 65
Celery 66
French Beans and Scarlet Runners 68
Jerusalem Artichokes 70
Kale 71
Kohl-Rabi 71
Leeks 72
Lettuce 73

PAGE
Onions - - - - - - - - - 74
Parsnips - - - - - - - - 75
Peas - - - - - - - - - 76
Potatoes - - - - - - - - 78
Radishes - - - - - - - - - 80
Spinach - - - - - - - - - 81
Tomatoes - - - - - - - - 82
Turnips and Swedes - - - - - 83

Herbs :
Mint - - - - - - - - - 84
Parsley - - - - - - - - 85
Sage - - - - - - - - - 86
Thyme - - - - - - - - - 87

Small Fruit :
The Common Characteristics of Currants, Gooseberries and Raspberries - - 87
Black Currants - - - - - - 89
Currants (Red and White) - - - - 89
Gooseberries - - - - - - - 90
Raspberries and Loganberries - - - 90
Rhubarb - - - - - - - - 91
Strawberries - - - - - - - 91

ADAM'S GARDEN

CHAPTER I

PHYSICAL CONDITIONS

1. The ideal situation for a garden is open, fully exposed to the sun, running north and south, with both sides of the rows in which vegetables are grown equally sunned, and having soil of a light brown colour, easily worked and lying about 3 feet deep over a subsoil which is porous enough to assist the drainage. Fortunately successful gardening is possible even when an ideal situation cannot be obtained.

2. Sunlight is of vital importance. The highest degree of success cannot be attained without liberal help from the sun. The weaker the light to which plants are subjected the more their stems are drawn out and weedy, while strong light tends to produce sturdy plants with short stems and relatively smaller leaves. In the latitudes of England situations looking towards the south or the south-west get most sunlight, and they absorb most heat from the sun if their soil is somewhat dark and dry. The receptivity of soil for heat varies with its colour and moisture, the darker and drier soils being the more receptive.

3. The extreme types of soil are clay, sand, chalk, and peat. But any one of these by itself is quite unsuitable for gardening purposes.

4. Clay is an important reservoir of plant food—notably potash, phosphate, and sulphur—but it cannot by itself enable plants to utilize its resources,

because it consists of extremely minute particles, which, under drying influences, cake into hard lumps or crumble into very fine powder, and, under the influence of moisture, form a mass so soapy, sticky and tenacious as to obstruct the passage of air and water. Plants do not thrive in wet clay, both because it excludes air from their roots and also because its excessive retention of moisture makes it a cold soil. But clay has a strong capillary action which is valuable in rendering underground moisture available for plants. If a thin tube, no thicker than a hair (*capilla*) and open at both ends, is placed with one of its ends in water, the water is forced up the tube ; water similarly rises up thin columns formed in the soil by minute soil particles clinging to each other like links in a chain ; this is what is known as capillary action ; and one of the objects of hoeing (para. 49) is to break before they reach the surface the thin columns of soil, which, if unbroken, would by their capillary action raise to the surface water from underground, with the result that that water would be lost by evaporation.

5. Sand in its character is exactly opposite to clay. Typical sand—the "sharp sand" recommended for potting—consists only of grains of hard, non-cohesive rock without any admixture of earthy substances. It has little capillary action and offers little obstruction to the passage of air and water. Its temperature is therefore variable, and sand is more liable than other soils to extremes of heat and cold. In pure sand there is no plant food except possibly silica.

6. Chalk, i.e., calcium carbonate or carbonate of lime, is essential for plant life. Soils which contain much of it are known as "calcareous." Chalk is whitish in colour ; its capillary action is good ; its porosity—i.e., its capacity for allowing water to

pass through it—is too great for an effective retention of moisture, and is intermediate between that of clay and sand ; it opens up clay and binds sand ; and it is fairly retentive of warmth. Chalk soils usually contain a fair amount of potash and phosphate.

7. Peat is more retentive of moisture than chalk and has a good capillary action, but it is still fairly porous. It is dark coloured and easily warmed. It is mainly a kind of humus, humus being the general name for the complex substance to which natural and bacterial agencies convert the so-called "decayed" remains of the growth and roots of vegetation as well as such animal remains as come within their influence. Bacteria are living things which in size are most extremely minute ; they act upon and so make changes in substances with which they come into contact ; they exist and work in such countless numbers that though they are themselves invisible, the sum total of their activities results in changes that are readily observed ; life as we know it could not exist without the help they give in changing substances from a form in which they are not useful for our purposes to one in which we can make use of them. Among their most important activities is that of converting into a form which can be used by plants substances which without such conversion are useless as plant food. It is to bacterial action that humus owes its richness as plant food. But it is important to bear in mind that acid is unfavourable for bacteria. Acidity in their surroundings prevents their full development. Moreover, acidity prevents the vegetables dealt with in this book from absorbing freely the plant food which exists in the soil. Therefore humus in which the acidity has been neutralized by lime is essential in a good vegetable garden soil because it

encourages the myriads of bacteria whose incessant labours result in the production of plant food and it also enables the vegetables to make use of that food when it has been got ready for them.

8. Most of the soils of England are known as "loams," i.e., soils of a texture intermediate between that of clay and sand. The value of loam varies according to the proportions of each of its main ingredients. In light loam sand predominates; a very heavy loam such as that known as "marl" contains a large amount of clay. The best loam has a light brown colour, is of moderately fine texture, is when dry or nearly so easily crumbled into small pieces, has good capillary action, is fairly retentive both of moisture and of warmth, but is not sticky, being loose enough to allow roots to grow and extend freely and firm enough to provide a secure hold for plants. If a soil suffers from the defects of one of its main ingredients it can be modified by adding to it an ingredient which remedies those defects. Thus the addition of sand or sandy soil, and particularly of chalk, improves and lightens clay. Mixture of soils obviously opens the way to great improvements. In small gardens much might be done in this matter, but farm-yard manure (para. 13) is the only substance which is freely used to modify soils, one of the most important functions of that manure being the improvement of the texture of the soil by the addition of humus and other substances which moderate the properties of the soil in respect of its retention of moisture.

9. A moderate action in respect of the retention of moisture is of prime importance in soil. If the soil is too retentive plants die in it because they stand in stagnant water, which shuts out the air essential for the roots of a healthy plant: if the

soil is not retentive enough plants die in it because it allows water to pass through it so rapidly as to fail in maintaining the regular and uninterrupted supply of moisture around the roots, which also is essential for the healthy growth of plants. As will appear from paragraph 36 below, a properly regulated supply of water is—provided that sunlight is also present—more vital to plant life than any other single factor. Too much attention cannot be devoted to this matter. In the composition of a healthy plant water forms very much the largest part ; as an illustration it may be noted that the amount of water in vegetables varies from about 75 per cent. of their weight in potatoes to about 90 per cent. in turnips and cabbages. Plants are healthiest when all their cells are distended with sap, which is nearly all water, and a very considerable amount of water, especially in hot and dry weather, passes out through the leaves of plants into the air. After they have begun to bear fruit plants want less water than in their earlier and growing stages, but the total amount required during all stages of growth is very great. If a column an inch high represents the total food requirements of a plant, then its water requirements on the same scale would need a column higher than the Nelson Monument in Trafalgar Square. This gives a graphic idea of the importance of water for plants, and how essential it is that their water supply should be constant, adequate and well-regulated.

10. Not only the soil but the subsoil as well must have satisfactory properties in connection with the retention of water. If the subsoil is not porous enough to provide adequate passage for surplus water, or if the conformation of the ground or anything else checks the free passage of such water, artificial drainage must be used. For this it may

suffice to dig trenches about 6 feet apart and about 3 feet deep—this depth is the most effective—and to fill them up again after putting in layers of broken bricks or rubbish at the bottom. An effective alternative is to dig all the ground to the depth of about 3 feet so that the soil at the bottom is loosened. But if there is no natural outfall by which the water drained from a garden is carried beyond it, more elaborate arrangements may be needed. If this is the case subsoil drainage must be carried out, for without it a really satisfactory return will never be secured on the time, labour and expense of which gardening involves the recurrent outlay.

CHAPTER II

THE IMPORTANCE OF ROTATION AND MANURING

11. Land ordinarily gives diminishing returns if only one class of crop is grown in it without change. The best results are secured from a system of rotation which periodically changes the crop grown. An example of a rotation would be the growing of crop A every third year, with crop B recurring in the series of years consisting of the second, fifth and eighth years and so on, and with crop C similarly recurring in the series of years which begins with the third and sixth. It might be argued that with absolutely correct manuring and soil replenishment rotation would serve no useful purpose. But experience does not support this argument. Rotation assists in the campaign against weeds, which are favoured by one crop more than by another, and it prevents the " sickness "—due to causes not fully understood—which affects certain crops grown year after year on the same land. In actual practice rotation must be regarded as a factor in gardening as important as manuring itself. Each crop uses up in its own way—different from that of other crops—the plant food which the soil contains. When a crop has drawn on the soil for its requirements in one season, the soil unless replenished may not be able to supply the same requirements again sufficiently in the next succeeding season. On the other hand, a succession of different crops ensures the full use of the whole range of plant foods con-

tained in the soil. At the same time it gives the soil an opportunity of drawing on its reserves and making available a further supply of a constituent which has been freely in demand by one crop, but is not so urgently needed by its successor. Thus cabbages and potatoes are especially severe in their demand for potash and nitrogen, and they can with advantage be succeeded by leguminous plants which while requiring some potash make special demands for phosphates and actually restore nitrogen to the soil. Moreover, while surface-rooted plants do not draw their food from any considerable depth in the soil, tap-rooted plants do so. For all these reasons it is essential to have a proper rotation, e.g., of tap-rooted plants with those that are surface-rooted, of plants that exhaust the potash in the soil with those that exhaust the phosphates, and so on. The demands of different vegetables for nitrogen phosphate and potash in mixtures of artificial fertilizers, set forth in paragraph 31 below, may serve as some guide in fixing a rotation of crops, but a practically binding rule for the owner-gardener is to avoid growing the same crop for two successive seasons in the same place.

A convenient three year rotation is :

In the first year, potatoes and celery ;
,, second ,, roots, bulbs, spinach, and lettuce ; and
,, third ,, the Brassica family—i.e., all kinds of cabbages, cauliflowers and turnips ; and leguminous plants—i.e., plants with pods which split open both at the front and the back, like those of peas and beans.

12. Another binding rule, based on similar considerations, is that an adequate quantity of appropriate manure must be given to every crop. Even when other factors are favourable, good vegetables cannot, without fertilizers, be grown for long in soil that is under constant cultivation. In such soil the consumption of plant food is continuous ; its exhaustion must result unless it is renewed ; but as it is always under a crop the soil never gets the chance even of a fallow for renewing its stores ; rotation affords only a partial solution of the difficulty ; and the only way of meeting the constant demands of constant cropping is the replenishment by sufficient and appropriate manuring of the plant food in the soil.

CHAPTER III

FARM-YARD MANURE

13. Hitherto fertilizers have generally been applied in the form of farm-yard manure. As a rule about 1 cwt., i.e., about 1 barrow-load, of such manure may with advantage be dug into each 10 square yards of ground. An important effect of the use of such manure is an improvement in the texture of the soil (para. 8). But there are crops, as noted in the detailed accounts of crops given below, which do not thrive on land containing farm-yard manure freshly dug in, and there are others for which the amount of such manure, even in a fresh state, cannot be too great. Therefore in the application of farm-yard manure regard must be had to the peculiar requirements of the particular crop for which it is used. If the scarcity or expense of farm-yard manure—which are now constantly increasing—are a serious obstacle to its adequate application, there is no reason to despair. Farm-yard manure is not indispensable. It need not be used at all if due provision is made otherwise for regulating the water-retentive properties of the soil and for maintaining its supply of humus. An adequate supply of humus is of vital importance, but if it is sufficient the other fertilizing agents which are required can be put into the soil in the form of chemicals more conveniently and more economically than in the form of farm-yard manure.

CHAPTER IV

OBJECTIONS URGED AGAINST THE USE OF ARTIFICIAL FERTILIZERS

14. Objections sometimes urged against the use of artificial fertilizers are that they exhaust the soil, that once used they cannot be discontinued, and that they need constant attention during the whole of the season in which they are used. An application of farm-yard manure introduces into the soil a large number of fertilizing agents each in a small quantity, but all together carried in a large volume of humus ; the fertilizing agents are only gradually absorbed, and on account of their variety and the bulk and fertilizing value of the material in which they are carried it takes a long time—perhaps several years—to exhaust them all. An application of an artificial fertilizer introduces into the soil only one fertilizing agent, and that only in a quantity which experience shows to be just sufficient for the crop under treatment ; its effect is not intended to last after that crop has utilized it, and a correct dose is exhausted after one crop. Thus artificial fertilizers are more direct in their action than farm-yard manure. Therefore they are capable of being more accurately adapted to the circumstances in which they are required. Accordingly, though it is true that certain of them neutralize in the soil matter which is beneficial for plants—e.g., sulphate of ammonia and sulphate of potassium take up a lot of lime (para. 15)—they themselves afford

simple and easy remedies for any impoverishment of the soil which can be charged against them. Thus lime-reduction by those artificial fertilizers that use up lime can, by the application of lime itself, be counteracted in such a way as to leave no ill-effects whatever; it has to be remembered that the application of lime to the land is necessary even when farm-yard manure is used; it is therefore not a new thing directly due to the use of artificial fertilizers; but with them it is easier than with farm-yard manure to apply the lime in exactly the quantities that are required. Similarly the action of certain artificial fertilizers in altering the texture of the soil—e.g., by reducing the freedom with which water passes through it—can be counteracted by using another substance which has an opposite action, and that without any harm being done to the soil. The need for constant renewal of the humus as it is used up by crops, to which the use of artificial fertilizers has drawn especial attention, is, like the need for applying lime, no new thing, and it presents no great difficulty. Whatever the fertilizing agent, it is naturally used up in the course of time by cropping; if it is not renewed, then, on account of the respective quantities applied, exhaustion after farm-yard manure takes longer to occur than after artificial fertilizers; after either it is equally certain to occur; but neither causes any damage to or change in the soil that cannot be remedied; and with the necessary precautions either can be discontinued and succeeded by the other. Moreover, each is capable of a single application without any renewal or addition during the growth of the crop for which it is intended. A complete artificial manure can be dug in once for all, just like farm-yard manure. It is more effective and more economical to dig in before the crop only such artificial fertilizers as are not easily washed out of the soil and to add nitrogen fertilizers during growth. But this is not essential—the nitrogen can be dug in like the rest. If it is not dug in it is best to apply it in small repeated doses, but even with some want of care and method in the use of nitrogen, good—though, of course, not the best—results can be secured from artificial fertilizers, just as in the case of farm-yard manure good—though not the best—results are secured when due regard is not had to such processes as mulching. In the use of artificial fertilizers, a rigid adherence to dates is not absolutely necessary ; if a weekly watering is advised it may be well enough to water at longer intervals when the plants seem to call for it. But though to use artificial fertilizers to the very best advantage certainly does require more care and attention than the use of farm-yard manure, that extra care and attention are more than repaid and some neglect in giving them does not involve a total failure. Keen gardeners who are always about their gardens and spend a lot of time in watering and weeding and looking after things, will find that artificial fertilizers used as recommended in this book add little to the trouble that even without them will assuredly be taken by those who really strive to get good results.

CHAPTER V

VARIETIES AND PROPERTIES OF ARTIFICIAL FERTILIZERS

15. Lime—calcium carbonate—is indispensable, and it is an artificial fertilizer that has been used universally and regularly by many generations of our predecessors. Some plants grown in gardens—e.g., rhododendrons, azaleas, and heaths (erica)—cannot bear lime, but all garden vegetables—with the exception of tomatoes, and to some extent of potatoes, French beans, and scarlet runners—thrive only on soil that has such alkaline properties as are produced by lime. Deficiency of lime is indicated by the presence in the members of the Brassica family of the disease known as club-root and finger-and-toe, and it is also indicated by the free growth of certain plants, among which may be mentioned spurrey, foxgloves, gorse, and ling. On the other hand the growth of clover, lucerne, vetches, lady's fingers, the common viper bugloss, and fumitory is evidence that the soil contains lime. Without lime most plants can extract no nourishment from the soil since their roots can absorb only water that has an alkaline reaction. Lime liberates the nitrogen and potash in the soil and makes it available for plants. It promotes bacterial life and must be present to secure the best results from bacterial action in the processes of nitrification and the decomposition of humus. It is also very useful in modifying the unfavourable features of

clay by causing its minute particles to cling together in small lumps and so behave as if it were composed not of a sticky mass through which water cannot pass but of a coarser texture—more easily worked and giving freer passage to water. If too liberally applied, or if applied repeatedly to soil in which the humus is not renewed, it may cause impoverishment. But it is especially required if sulphate of ammonia (para. 18) or sulphate of potassium (para. 23) are used, because these fertilizers use up lime. Lime is also especially wanted when superphosphate of lime (para. 21) is used, because the superphosphate has an acid reaction which lime counteracts. The lime required in connection with these three fertilizers should be put into the ground at least 14 days before the application of the fertilizer, for otherwise the chemical reaction which takes place between the lime and the fertilizer impairs the efficiency of both. Independently of the direct action of these fertilizers lime is constantly being lost by being washed out or removed from the soil by natural agencies, particularly in a smoky neighbourhood. Accordingly its constant application is necessary. As a rule the best time to apply it is the beginning of winter or from the middle of January to the middle of March. It may be applied effectively in the form of quicklime ground fine, and slaked immediately before use, at the rate of at least two ounces for each square yard of the garden. This is a moderate allowance appropriate for soils such as clay, which do not ordinarily require the addition of much lime ; very many soils, however, benefit by a more liberal application of lime, which may with safety in very many cases be increased beyond 2 ounces for each square yard ; while in soils where lime is markedly deficient twice or three times this quantity would not be excessive. Quick-lime slaked just before use has the advantage of being reduced to a state of great fineness which facilitates even distribution. But quick-lime will not keep and it is not very easy to handle. As good effects are produced by slaked lime, i.e., lime slaked a considerable time before it is used, by lime-stone, or by chalk, if these are powdered fine enough for even distribution. If they are spread over the ground and left there in frosty weather, the frost is a good agency for making them powdery. They should be used in quantities twice as great as is recommended for quick-lime, or, with the three fertilizers mentioned above, even more liberally. They keep well and are more convenient to handle than quick-lime, and they can be applied at any time, even to a crop in the ground, whereas quick-lime must be applied at least a fortnight before a crop is sown. All lime however should be dug in deep, and as long as possible before the sowing of crops, since it takes time for rain and other natural agencies to cause it to sink into and distribute through the soil.

16. It will obviously be convenient to use as few as possible different kinds of other artificial fertilizers. Three will suffice, viz.: sulphate of ammonia (para. 18), superphosphate of lime (para. 21), and sulphate of potassium (para. 23). If others are desired they can be substituted as noted below in paragraphs 18, 21, and 23. The three selected do not deteriorate if kept dry; they dissolve readily in water and provide in a soluble form practically all that it is necessary to put into the soil in order to secure vigorous plant growth; they are quick acting; they can be applied to plants during growth, provided that if applied so as to touch the leaves they are in dilute solution, for otherwise they, like other artificial fertilizers,

will burn the leaves; they can be mixed together without any disadvantageous reaction if they are not kept very long after mixture. In view of the chemical reactions that take place between certain fertilizers this last point is of importance; some cases of reaction are noted in this book, but in the absence of exact information on the matter different artificial fertilizers should be mixed together only after it has been ascertained that their mixture does not cause any chemical reaction which is objectionable from a horticultural point of view. With the use of the fertilizers recommended above the amount of nitrogen phosphate and potash which each plant requires can be given to it exactly. This cannot be done by the use of proprietary mixtures, which, moreover, are much dearer than mixtures made with the three fertilizers selected.

17. Nitrogen promotes growth and so gives power to resist the attacks of plant pests. By developing and strengthening roots and leaves it enables plants to make full use of the sustenance they can extract from their surroundings. It should not be used alone, but in combination with phosphate and potash. Nitrogen fertilizers, however, need not be mixed with phosphate and potash fertilizers at the time when the latter are applied. Nitrogen fertilizers are easily washed out of the soil and will probably be to some extent wasted if they are dug in before the crop for which they are intended is ready to use them. Seedlings have some store of nitrogen in their seeds and do not want an additional supply till that store is exhausted. In the early months of the year the soil is poorest in the forms of nitrogen which plants use, because the cold then limits the activities of the bacteria which convert into plant food nitrogen found in the soil

in forms which plants cannot use; bacterial conversion is the principal agency for the supply of nitrogen for plants, and this conversion cannot effectively be carried on in soil so cold as it is in an English winter. Accordingly it is in the early part of the year that the application of nitrogen fertilizers is likely to have the most effect in promoting growth. The application of nitrogen should generally cease when leaf or flower production is no longer desired. Nitrogen is necessary for the production of good fruit, but in excess it leads to rankness of foliage, reduces fruit production, and retards ripening.

18. Sulphate of ammonia is a good vehicle for the application of nitrogen to the soil, but it uses up lime and may do harm unless the soil is limed before the sulphate is used (para. 15). There is a neutral variety of the sulphate from which acidity has been almost entirely eliminated, and this form does not exhaust any lime in the soil. The form in which most plants use nitrogen is that of nitrates, and it may be that plants use it in no other form. Thus the sulphate must be converted into a nitrate before plants can utilize it, and it is not so quick in action as nitrate of soda. This latter is more readily dissolved in water and more quickly washed out of the soil, but it contains soda in a form which to some extent takes the place of potash in the stimulation of plants; it causes no loss of lime and can be used in a soil which is not rich in lime; it can be stored in a dry place without deterioration; but it cannot be used with superphosphate of lime (para. 21) except in a fresh mixture less than 24 hours old; and if its use is long continued the soil becomes less capable of allowing water to pass through it freely, because it breaks clay up into very minute particles which impede the flow of

water. If used in a mixture together sulphate of ammonia and nitrate of soda react upon each other so as to produce no loss of lime or hindrance to the free passage of water. Nitrate of soda contains about 15 per cent. of nitrogen as against about 20 per cent. in sulphate of ammonia, but its quicker action makes it in practice about as effective as sulphate of ammonia of the same weight; one ounce of sulphate of ammonia and one ounce of nitrate of soda may be regarded as of equal value for fertilizing purposes in an ordinary garden.

19. The nitrogen requirements of the vegetables dealt with in this book are indicated in the notes on separate crops which follow below. Nitrogen is especially required by cabbages and other plants grown for the use of their leaves alone. It is not much required by potatoes or by leguminous plants, and it may harm them if applied to them before they have passed fairly out of the seedling stage; through the agency of bacteria associated with them leguminous plants extract nitrogen from their surroundings and leave the soil richer in nitrogen than they find it. In the early part of the year nitrogen can best be applied in the form of nitrate of soda, since plants can use this with a minimum of bacterial assistance. In warm weather a mixture of equal weights of this nitrate and of sulphate of ammonia is best. The rule should be to apply a nitrogen fertilizer by itself after active growth has been established, and in frequent small does rather than in strong doses only occasionally. For repeated doses an appropriate strength is one-eighth of an ounce of either nitrate of soda or sulphate of ammonia by itself or of a mixture of the two, dissolved in a gallon of water, or else a solution of poultry dung may be used (para 28).

The recommendations made below as to watering with a solution of this strength may involve the application of more nitrogen than according to the table in paragraph 31 is necessary. But the nitrogen will be applied in a stage of growth at which it will do no harm, it will soon be washed out of the soil, and it is as a rule not superabundant in the soil. Moreover, there is an index which warns us to shut off the supply of nitrogen when it is not required; as long as a plant has foliage of a clear deepish green, without any pronounced yellow tone, full of sap and free of flabbiness, a nitrogen fertilizer is beneficial, but otherwise the fertilizer should be discontinued.

20. Phosphate is not readily washed out of the soil, and it can with advantage be dug in some time before the sowing or planting out of the crop for which it is required. It has a markedly beneficial effect on soil bacteria; it matures roots and stems by making woody material in plants in the same way as bones are formed in animals; it particularly develops root formation in the early stages of plant life and therefore is especially valuable in soil such as clay, where roots do not form so readily as in open soil; in the later stages of plant life it promotes both the number and the quality of seeds and fruits and it hastens flowering and ripening. It is very valuable for root-crops and indispensable for leguminous plants, while if members of the cabbage family are slow in forming hearts, heads or sprouts or if turnips fail to bulb phosphate is usually deficient.

21. Superphosphate of lime contains some calcium phosphate, which is sparingly soluble in water and remains as a sediment when a solution of the superphosphate is made, but its main constituent is a mono-calcium phosphate which dissolves

readily in water. It causes the minute particles of clay to unite and so improves their capacity for allowing water to pass through. It has an acid reaction which is valuable in alkaline soils having an excess of lime. For soils that are deficient in lime basic slag may be a better vehicle for the introduction of phosphate, though the considerable quantity of lime which it contains is not available in a form that is effective as a remedy for acidity in the soil. Neither superphosphate of lime nor basic slag contains lime in the form of calcium carbonate discussed in paragraph 15 above. The phosphate in basic slag is insoluble in water, so that this fertilizer is slower in action than superphosphate, and it must be dug into the soil at least three or four months before the sowing or planting out of the crop for which it is intended. In order that it may be diffused as thoroughly as possible through the soil, it is advisable to dig in superphosphate as well some time before the crop for which it is intended. As a rule the percentage of soluble phosphate in superphosphate of lime is about 30, while the percentage of phosphate in basic slag is about 40, but in view of the difference in solubility and the consequent difference in action of the two fertilizers the quantity of basic slag generally used is 1½ times that of the superphosphate.

22. Potash like phosphate is retained in the soil to which it is applied, and can also with advantage be dug in some time before the sowing or planting out of the crop for which it is intended. By imparting vigour to plants it strengthens their power to resist unfavourable conditions and disease, and it increases their period of vitality. But its special function is that of improving the size and weight of roots, seeds and fruits. It is essential in the

cultivation of sugar-producing plants, especially potatoes, tomatoes, and root-crops, and it has a markedly beneficial effect on leguminous crops. But members of the cabbage tribe do not require much of it and can avail themselves of the store of potash already in the soil to a greater extent than most other plants.

23. Potash is conveniently applied in the form of potassium sulphate, which should contain about 40 per cent. of potash. It exhausts lime from the soil so that if it is used liming (para. 15) is very necessary. Another convenient form of potash fertilizer is Kainit which is soluble in water and contains about 20 per cent. of potash, as well as a mixture of common and magnesium salts. In substituting Kainit for sulphate of potassium the amount used should be about 2½ times that recommended for the sulphate.

24. Humus—decayed vegetable matter—(para. 7) is of the very greatest importance as a medium for the growth of crops. Without a liberal supply of humus in the soil crops cannot succeed. In paragraph 13 it is noted that the use of artificial fertilizers has emphasized the need for humus, but in paragraph 14 it is pointed out that as crops naturally use up the humus this constituent of a fertile soil must constantly be renewed, whether artificial fertilizers are used or not. Farm-yard manure, in the composition of which humus bulks largely, introduces this constituent into the soil to a degree which is largely in excess of actual immediate requirements. Thus in ordinarily good soil the difficulty of maintaining a supply of humus as a basis for the operation of artificial fertilizers would be solved if occasionally in the course of years an application of farm-yard manure were made. But in such soil other less expensive measures will

usually suffice. If a soil starts with a good average proportion of humus, what is required is system and care in the utilization of refuse matter produced in the garden or thrown out of the kitchen which contains the materials of excellent humus. Such matter is now commonly wasted in surprisingly large quantities. All of it can be utilized to great advantage. Such matter includes all grass cuttings, all leaf sweepings, all hedge clippings, all vegetable matter taken up in the process of weeding, all loppings and rejected parts of vegetables and other plants—leaves, stalks, etc.—except those that are infected with a disease (club-root, etc.), and all vegetable matter thrown by the cook out of the kitchen, such as the leaves and stalks of cabbages and lettuces, the pods of peas and beans, and the parings and skins of potatoes and fruit. Even rags and waste paper may be utilized. None of these things should be burned. If burnt their ashes are no doubt valuable, especially because they contain potash; but a good deal of this is washed away and wasted: the potash required can be more economically and easily supplied to the soil in the form of an artificial fertilizer; and burning destroys its properties as a basis of humus, which gives its real value to all this so-called rubbish or refuse. It should all be saved methodically, for if properly treated it is invaluable for gardening purposes. Without causing any obnoxious smell or any nuisance whatever, this matter can be turned into stuff very useful for the garden merely if it is kept in a heap for one year, being exposed to the action of the weather and particularly of rain, and being occasionally turned over to ensure its thorough exposure. But this is not enough to convert it into real humus. A most efficient agent for doing this is now available in the form of a preparation sold under the name of "Adco." This has been developed from the results of investigations made in the Rothamsted Experimental Station of the Lawes Agricultural Trust. The investigations aimed at obtaining a definite control of the processes of the decomposition of cellulosic material. Their original object was not agricultural. As a war-time development the results were applied to agricultural purposes by the treatment of cellulose in the form of stalks, leaves, and other vegetable matter. The success that has been secured is set forth clearly in an article published in "The Gardeners' Chronicle," which can be obtained from the author, Mr. W. Auton, Pyrford Court Gardens, Woking, in the form of a pamphlet published for 6½d. post free. The author explains how to use Adco and shows that with its help material thoroughly fit for garden use can be obtained in a few weeks from soft green matter, dead leaves, and dry litter, and in 2 or 3 months from fibrous and woody matter, such as prunings and hedge trimmings. Mr. Auton concludes that experiments at Pyrford which have lasted for two years "prove conclusively that weight for weight the vegetable manure is decidedly superior to farm-yard manure." Thus Adco solves the problem of quickly obtaining good fertilizing material from garden and other refuse. In some cases, however, the quantity so obtained may not suffice—e.g., when the soil is stiff clay or dry gravel with an obvious and marked deficiency of humus. In such cases special measures must, if possible, be taken; farm-yard manure may be used or shoddy or some other appropriate material of sufficient bulk. But in every case all the decayed vegetable matter that can be got—preferably after treatment with Adco—should be dug in. Even a slight improvement year by year will in the course of time make a marked change for the better. No means for making good the supply of humus can be neglected, for—to repeat—crops can not succeed unless they have enough humus to grow in.

25. Common salt, such as is sold at cheap rates for agricultural purposes, is a good artificial fertilizer. In excess it is harmful, for it dissolves so freely in water as readily to make a solution strong enough to extract water from the sap of plants (see para. 36). But in moderation it is useful, especially as to some extent it takes the place of potash and it also makes potash fertilizers more effective. It has a particularly beneficial effect on chalk soils, and on soils affected by club-root. It assists plants to resist the action of sudden frost by entering into their sap and raising its freezing point above 32° F. It is not liked by some plants—e.g., roses—but the whole of a vegetable or fruit garden can with advantage be treated in March every year to an application of salt. This should be applied on the average at the rate of 2 or 3 ounces to the square yard. Certain vegetables may well have even more; their partiality for salt is noted in the detailed notes below on different kinds of vegetables. A chemical reaction objectionable from the horticultural point of view results from the mixture of salt with superphosphate of lime or with sulphate of potassium; salt should not be dug into the ground in a mixture with these two fertilizers; an interval of at least 14 days must elapse between the application of salt and of the superphosphate or sulphate. But there is no objection to mixing salt with lime (para. 15); salt and lime can be mixed and dug into the ground at the same time.

26. Soot may have about 4 per cent. of ammonia. To give equivalent quantities of nitrogen, 6 times the quantity recommended for sulphate of ammonia should be given in soot. The chief use of soot is that of discouraging and keeping off insect pests, but it also improves colour in roses and other flowers.

27. Wood ashes contain a good deal of potash and some phosphate. They are specially valuable for potatoes and root-crops. But they are also of general value on account of their action in keeping off insect pests.

28. Poultry dung kept under cover and so allowed to dry for at least one month has nearly 4 per cent. of nitrogen and a little over 5 per cent. of soluble phosphate. Thus without dilution or mixture it is not a well-balanced general fertilizer, because its large nitrogen content may unduly force the growth of plants for which it fails to supply adequate maturing material. But it is excellent as a means of supplying nitrogen to plants for which a sufficient supply of maturing material is otherwise provided. Four or five ounces of dried poultry dung dissolved in a gallon of water can well be used in place of the nitrogen fertilizer mixture recommended for watering plants in paragraph 19 above. Poultry dung can also be used as a component of a complete fertilizer, but such a complete fertilizer is practically as expensive as one made otherwise, and the best way of using poultry dung is for the watering of plants which have had an adequate supply of all that they require except nitrogen.

29. Sulphate of iron (ferrous sulphate) has no effect upon the growth of plants, but some people consider that it increases colour when applied from time to time at the rate of half an ounce in a gallon of water. With soluble sulphate

it forms an insoluble iron phosphate, so that the two cannot be used for the same plant except with an interval of time between their applications long enough to deprive them of an opportunity of reacting directly on each other.

CHAPTER VI

THE PRACTICAL APPLICATION OF ARTIFICIAL FERTILIZERS

30. To ascertain what percentage of each of the constituents—nitrogen, soluble phosphate, or potash—is contained in a mixture of artificial fertilizers, multiply the weight of the material containing that constituent by the percentage of the constituent in that material, and then divide the product by the weight of the whole of the mixture of which the material forms a part. With good standard quality it may be assumed that—

Sulphate of ammonia contains about 20 per cent. of nitrogen;

Superphosphate of lime contains about 30 per cent. of soluble phosphate; and

Sulphate of potassium contains about 48 per cent. of potash.

31. In the table below are compared the percentages of nitrogen, soluble phosphate, and potash contained in farm-yard manure, in ichthemic guano, and in the mixtures which are here recommended for each of the vegetable crops dealt with in the detailed notes on crops that follow in this book. In case it is not desired to particularize for each crop a mixture is suggested also for general use, and this is appropriate for general use with flowers as well. It is not suggested that the proportions of the constituents recommended in each of the mixtures are of mathematical correctness and

incapable of modification, but experience has proved that they are sound for use on ordinary garden soils. Stronger mixtures may indeed be used, but artificial fertilizers in excess do harm, and both for this reason and because economy is one of the advantages offered by them, as little as possible should be used of the necessary constituents. The table is as follows :

Fertilizer.	Weight in ounces of each material in a mixture appropriate for application dry to 1 sq. yd. of land (para. 33), or for application dissolved in 1 gallon of water.			Percentages of the different constituents in each mixture.		
	Sulph. of Am. para.18	Superph. of Lime para.21	Sulph. of Potass. para.23	Nitrogen.	Phosph.	Potash
Farmyard manure ...	—	—	—	·59	1·0	2·6
Ichthemic guano ...	—	—	—	3·50	9·0	1·1
For general use	·75	2·00	·40	4·7	19·0	6·0
,, potatoes and Jerusalem Artichokes ...	·25	2·00	·75	1·7	20·0	12·0
,, peas and beans ...	·25	2·00	·25	2·0	24·0	4·8
,, turnips and knolkohl	·50	2·00	·25	3·6	22·0	4·3
,, cabbages and cauliflowers	1·00	2·00	·25	6·1	18·5	3·7
,, carrots	1·00	1·50	·25	7·3	16·4	4·8
,, leeks and onions ...	·75	1·50	·25	6·0	18·0	4·8
,, beetroot and parsnips	·50	1·50	·25	4·4	20·0	5·3
,, celery and radishes ...	·50	1·50	·50	4·0	18·0	9·6
,, tomatoes	·50	2·00	1·00	2·8	17·7	13·7

32. The quantities required for a mixture should always if possible be weighed out carefully, but for small amounts they might well enough be used by measure, provided that a really accurate measure is available for each fertilizer. If no weights or accurate measures are at hand rough estimates may have to take their place. But as the same bulk of different fertilizers has different weights, and as the capacity of ordinary utensils, such as spoons,

of the same name is not constant, rough estimates are difficult to make. The best can perhaps be based on the fact that the standard tea-spoon holds exactly one fluid dram. Many tea-spoons are larger or smaller, but assuming that a tea-spoon is used which has the capacity of just one fluid dram, then if the fertilizer is measured in it, dry, well-powdered, free from lumps, and "struck" with a knife or other straight edge so as to fill the spoon exactly, it may for practical purposes be estimated that:

One ounce of	Equals about	Each teaspoonful weighing
Superphosphate of lime ...	10 teaspoonsfuls	·10 oz.
Sulphate of ammonia ...	8½ ,,	·117 oz.
Nitrate of soda	6 ,,	·175 oz.
Potassium sulphate... ...	5 ,,	·21 oz.

33. Natural agencies are not very quick in carrying artificial fertilizers into the soil or in distributing them through it. Therefore to make sure of their reaching the roots of the crops, fertilizers should be dug in practically to the depth at which the roots will require them. For leguminous plants only a little of the fertilizer should be deposited near the surface of the ground, and the bulk of it should be buried over 9 inches below; root-crops want most of their fertilizer at or just below their ordinary depth of growth; while for other crops some of the fertilizer should be mixed in the top layer of the soil, but a good deal should go down to a depth of at least 7 or 8 inches. When plants are grown in rows or drills the quantities set forth in the table in paragraph 31 are to be used on the assumption that every 3 feet of run, in view of the area affected on each side of it,

requires as much fertilizer as one square yard of garden. If an artificial fertilizer is applied in liquid form, every watering with one gallon of the liquid will ordinarily cover one square yard.

34. For the different crops dealt with in this book, and for their cultivation in ordinary garden soil, the recommendations made in paragraphs 15, 25, and 31 may be summarized as follows, viz. :

Quantity required for each square yard of garden.				For
Slaked Lime para. 15	Salt para. 25	Superph. of Lime para. 21	Sulphate of Potass. para. 23	
oz.	oz.	oz.	oz.	
3	1	2	¾	Potatoes and Jerusalem Artichokes.
5	1½	2	⅓	Celery and Radishes.
3	1	2	¼	French and Runner Beans.
5	1	2	¼	Peas and Broad Beans.
5	1½	2	¼	All members of the Brassica family.
3	1	1½	¼	Leeks, Lettuce and Spinach.
3	3	1½	¼	Beetroot.
4	1	1½	¼	Carrots, Parsnips and Onions.

This table refers to the lime constituent in terms of slaked lime, makes no mention of tomatoes, and omits the nitrogen fertilizer required by the different crops. If slaked lime is not used the quantity of other material to be substituted for it can be ascertained in paragraph 15. Tomatoes are best grown in pots, according to the directions given below in the separate notes on this crop. Nitrogen fertilizers are omitted because it is generally not advisable to dig them into the ground before a crop is sown or planted out (para. 17). The table includes only those fertilizers which should be dug in (para. 20 and 22).

35. This book is intended mainly to help those who cultivate their gardens or allotments without

assistance and can devote to them only such spare time as other more pressing occupations allow. Such persons will probably do best by treating the whole of their gardens on general lines, and by avoiding as far as is possible the special treatment of particular crops. The following procedure will meet their requirements; modifications required for the special treatment of particular crops can, if desired, be made without difficulty from the information given in this book.

35 (1). The first thing necessary is a decision as to what shall be grown and in what plot. This involves consideration of the character of the soil. To sow carrots in stiff clay or broccoli in light sand is to ride for a fall.

35 (2). The vital importance of a sufficiency of humus must always be kept in mind. Action on the lines recommended in paragraph 24 above is essential for the introduction or renewal of an adequate supply of this indispensable constituent of a fertile soil. Without humus crops cannot prosper.

35 (3). When the ground has been cleared in the autumn or winter, but not later than the middle of March, it should be well dug, particularly any plot intended for a crop which requires especially deep digging. During this operation 3 or 4 ounces of slaked lime or its equivalent (para. 15) and 1 or 2 ounces of salt should be dug into each square yard unless the constitution of the soil is known to require more or less, in which case the quantity supplied should suit the local conditions. If wood ashes are available they may also be dug in for plots in which the crops will derive special benefit from them.

35 (4). Not less than 14 days after the first digging a mixture of 2 ounces of superphosphate of lime

and nearly half an ounce (·40 ounce) of sulphate of potassium should be dug into each square yard. Digging in to a depth of one foot and mixing with the soil to that depth will suffice. To secure the even distribution of the fertilizers they should be mixed thoroughly with several times their own bulk of dry ashes or fine dry earth, and they should be thrown into the soil in small quantities as the digging proceeds.

35 (5). After a crop has established itself well in the seedling stage it should be watered with a nitrogen fertilizer, according to its requirements as stated in the detailed notes on crops below. But if this cannot conveniently be done, it will serve to water it at intervals, say, of 10 days or a fortnight, or even to water it only when it shows any sign of losing vigour. Reference should be made to paragraph 19 above regarding the fertilizers to be used and the extent to which they should be diluted.

35 (6). If the fertilizers required have not been dug in before a crop is sown or planted out they can be supplied during the growth of the crop, either in solution, mixed with water and applied to the ground all round the crop, or else in a dry state spread over that ground as evenly as possible. The trouble is to get the fertilizers far enough down for deep roots. The even application of dry fertilizers is inconvenient and troublesome, particularly in heavy soils, if the surface of the soil is wet. For ease in handling, dry earth or dry ashes should be added to the fertilizer mixture and this should then be spread evenly over the soil and hoed or pricked in lightly with a fork, just before a good fall of rain is expected. If there is not a good fall of rain soon after, the soil must be watered copiously enough to ensure that the fertilizers are

carried well down. Lime and salt, if not dug in, can be applied in the way recommended for dry fertilizers.

36. Plants can absorb food from the soil only by means of their fine roots. These have a covering which allows the passage through them of water and of solid matter held in solution by water. When the roots are filled with liquid and are surrounded by a liquid solution, portions of the liquid as well as portions of any substance held in solution by it pass through the root covering because the liquid on both sides of that covering strives to arrive at an equal degree of dilution. To do this, the side on which the solution is the stronger takes from the other side some of its liquid, and this liquid carries over with it some of the substance it holds in solution. Accordingly roots can absorb water and the food it carries only if their sap holds in solution more solid matter than is held in solution by the surrounding water; if the surrounding water holds more solid in solution the roots are unable to absorb it; in fact a solution stronger than the sap robs the plant and extracts water from it. So if a plant is offered water with too much solid in solution the effect is the same as, or even worse than, if no water at all were offered to it. These facts which have been studied in connection with what is known as osmosis must be borne in mind when the use of artificial fertilizers is under consideration. In nature roots absorb food from water containing solid matter in very dilute solution. As an ordinary thing solutions from which plants take their nourishment may have up to 1 per cent. of solid. Usually they have much less. Plants would probably be unable to derive benefit from water which had in solution solid amounting to as much as 4 or 5 per cent. of its

volume. Now, 13 standard teaspoonfuls of a solid, say, an artificial fertilizer, are equivalent in volume to 13 drams, and if this is dissolved in a gallon of water, which has a volume amounting to 1,280 drams, we have a solution with about 1 per cent. of solid matter in it. A solution which reached the roots of plants in this strength would probably be as strong as the plants could utilize conveniently. Soil, however, has the property of selecting and clinging to particles of solids passing through it and this quality would tend to reduce the strength of a solution before it reached the roots. Accordingly a solution of very many teaspoonfuls in a gallon of water can be applied to plants without harm. But obviously there is a risk in strong solutions. Yet there is no need to take any risk or to approach the danger point of strength. In fact a weak solution has an advantage over a strong one, because the intensity of a plant's absorption of the solid offered to it in a solution varies with the extent to which the sap is more or less dilute than the solution ; the greater the comparative dilution of the solution the more readily is it absorbed. Some of the solutions recommended in this book seem weak, but there is good reason for their weakness. They are strong enough to give plants all the special stimulant they require, but not so strong as to involve any risk to the plants or to discourage the plants' ready absorption of the fertilizer which they offer. Moreover, no harm will be caused to the foliage even of seedlings by coming into contact with any solution of the strength recommended in this book for watering. A dose of fertilizer can, of course, be repeated as often as it is beneficial and the use of weak doses repeated if required is the right policy to adopt with artificial fertilizers, especially when applied in solutions.

CHAPTER VII

CULTIVATION

37. It is not without significance that, even before dung or other stimulants were used, the preparation of the soil for cultivation was known as manuring. Hand-work, devoted to the effective preparation of the soil, is an essential factor in the successful cultivation of all vegetables, without exception. Soil favourable for the growth of vegetables must be loose. Unless it is broken and opened up by digging it is hard and unfavourable to growth. The necessity for digging—and in some cases for digging deep—must be accepted as an axiom to be applied effectively in practice. Digging done in the autumn is better than that done later as it exposes the soil to the disintegrating action of frost and gives the soil a better chance of becoming aerated and settling down. But in default of autumn digging the soil must be well dug in the spring.

38. Before seeds are sown, whether in pans, seed-beds or drills, the soil which is to receive them must be carefully prepared. It must be worked to a fair depth into a fine state, quite free from clods and rough pieces, and it must be made firm and even. The object of making it firm is to increase capillary action (para. 4) and thereby secure the advantage of subsoil moisture for the seedlings. Moreover, if the seed-bed is covered with leaves or litter this will prevent loss from capillary action by evaporation,

and it will also prevent a fall in the temperature of the soil, to the benefit of germination which always requires, at least in the early part of the year, as much heat as can be maintained in the soil. When protection from frost is important, sacks or mats may be used as a covering. Some seeds have to be sown at a fair depth, as mentioned below in the notes on different vegetables, but where the depth required is less than ¼ inch the sowing should be very shallow; for shallow sowing the seed should be scattered lightly on the surface of the soil and then covered with a thin sprinkling of fine earth, the surface being finally made firm and even.

39. That very little seed is wanted will be apparent from the notes below on the different vegetables as to the quantities which suffice for a row of 50 feet. Sow thin. Nothing is gained and a good deal is lost by thick sowing. Seed is lost, the seedlings are started with the avoidable handicap of overcrowding, and labour in putting things right is lost at a time when gardeners have much urgent work to do. If seedlings are overcrowded they are denied the space and nourishment which they must have for healthy growth and they come up as weaklings, of which very few are fit to keep and most have to be uprooted and thrown away.

40. If seeds are sown under cover in pans, sowing can be undertaken very early in the year. After, or without, transplantation into seed-boxes kept under cover the seedlings can be planted out into the open as soon as the weather permits. Tomatoes, celery, and, if large specimens are required, leeks and onions, should be started early in heat, as well as other transplantable (para. 44) vegetables which are wanted before they can usually be got by open-

air cultivation ; a temperature of 50° F. is enough, and this can be secured in a small greenhouse by the use of an oil stove kept burning continually. The seedlings must be accustomed gradually to lower temperatures before their transfer to the open. In the absence of facilities for raising seeds in heat owner-gardeners can buy seedlings from nursery gardeners at the time when they are required for planting out. Broad beans and peas are sown in the open very early in the year : for other vegetables, unless specially early crops are required, the end of March or the beginning of April is about the earliest time to undertake sowings in the open. From March open air sowings go on through April to May, when the latest seeds should be put into the ground. Meanwhile repetition sowings are made in order to secure a succession of crops of the same variety. These are continued to the end of July or even later, though after July only quick-maturing varieties should be sown. Sowings for the winter come round from August. But no date for any sowings at all can be fixed definitely by the calendar. The weather is the determining factor, and this must be watched. In the case of most vegetables open air sowings can be undertaken with profit only when there is no imminent risk of frost. Ordinarily safe dates are suggested below in the detailed notes on different vegetables, but the generally accepted dates may not infrequently be accelerated as they may often be retarded by the mildness or severity of the season. If the average dates are accelerated risk of damage by frost must always be borne in mind, and in the case of all very early sowings the gardener must be prepared to see all his seedlings killed off.

41. The number of days which is required for the germination of seeds of different kinds can be stated

only in very approximate terms. Conditions vary as to the age of the seeds sown, the depth of their sowing, and the soil moisture and heat in which they are germinated. The periods given below in the notes which deal with different vegetables are average periods of germination for seeds sown in conditions such as ordinarily obtain in the open, except in the case of celery and tomatoes, for which the periods are for seeds sown under glass. When artificial fertilizers are put into the ground at the same time as seeds, they probably retard germination to some extent.

42. A sufficiency of moisture is essential for germination, and seedlings in the early stages of their growth must be constantly and regularly supplied with moisture. But they must not be saturated or kept too moist. In their early stages they may also with advantage be protected from strong sunlight by a covering of litter or leaves. If frost threatens such a covering or one of sacks or mats should be given to them. The object of such a covering has been noted in paragraph 38.

43. Even when the roots of plants do not spread out sideways, as they commonly do, they draw nourishment from the soil a little distance around them ; when plants are close to each other their roots compete for nourishment in the same ground ; each of the competing plants is thus to some extent starved ; and if they are to flourish plants must be thinned out so as to leave only as many as the ground can properly maintain. This point has been noticed already in paragraph 39. It is better to thin out very severely and to have comparatively few plants all good, than to neglect or be afraid of thinning and to have a crowd of plants all weaklings. To be of real use thinning must be effected drastically. It should be commenced when the seedlings

are well established and about two or three inches high, and it should be continued gradually as occasion demands or opportunity permits. Soil disturbed in removing seedlings for thinning out should always be made firm and even.

44. The notes below on different kinds of vegetables indicate what kinds of vegetables will stand transplantation. If a vegetable will stand transplantation its seedlings taken up in the process of thinning out can be utilized for filling up blanks or for making fresh rows. When a vegetable will not stand transplantation its seedlings are of no use after they have been removed from the ground. Such are the seedlings of beetroot, carrots, parsnips, and turnips; all other vegetable seedlings can be transplanted, but as is noted in the next succeeding paragraph transplantation is not in all cases advisable.

45. The effect of transplantation underground may in some respects be compared with that of pruning above ground. Pruning encourages the growth of side shoots; transplantation alters the character of root development, so that side growths are thrown out which without it would not have been produced. An excessive development, however, of roots checks seed production, and the converse also holds true. Accordingly with plants of which the seeds are required for use, such as peas and beans, the normal root development should be disturbed as little as possible, and such plants should not be transplanted. On the other hand, advantage is gained from the transplantation of vegetables such as cabbages which it is desired to prevent from seeding. Tap-rooted vegetables, as is noted in the preceding paragraph, do not benefit from transplantation because this spoils them for kitchen use by causing their roots to branch or

fork, but transplantation is especially advantageous in the case of onions, provided their bulbs are kept above ground. Transplantation prevents too luxurious a foliage and too early flowering, encourages such processes as hearting and bulbing, and checks the early production of seed.

46. Particular care must be taken with all transplanting to ensure that it interferes as little as possible with the growth of plants, for growth ought to be uninterrupted from the time of germination to the time of maturity. When very small seedlings are transplanted their roots should be protected by careful handling and by insertion into holes large enough to receive them comfortably without cramping them. With larger plants a ball of earth should be taken up with the roots large enough and firm enough to make as small as possible the disturbance which the roots have to suffer. Unless the contrary is stated in the separate account below of any vegetable, as for instance the onion, seedlings and plants should be transplanted so that the whole of their stem down to their lowest leaf is under ground. This is of great practical importance, because the tender parts of the plant require the protection and support of the soil, and their exposure above the soil will result in the wilting or death of the plant.

47. Plants should be transplanted into firm soil and the soil around their roots should after transplantation be pressed or trodden down until it becomes firm. This should be done for the reason noted in paragraph 38, that of assisting capillary action in keeping the roots moist. Firm soil has also the advantage of discouraging insect pests by increasing the difficulty they find in penetrating the soil for the purpose of laying eggs or feeding on roots. Even with plants that mature where they

are sown and are not transplanted the maintenance of a firm and even surface on the soil immediately around them is in their earlier stages a matter of importance. It should therefore be regarded as a rule for constant application that the surface of the soil round all young plants must be kept firm and even. When, however, the roots of plants have attained some depth, it is not so necessary to bring up for them the underground moisture, but hoeing should then be used to prevent the escape of moisture from the surface by evaporation.

48. If seedlings are to be transplanted they should be moved first when they have made two or three perfect leaves. They should then be transplanted with a distance of about 4 inches from their neighbours in every direction. When they have four or five perfect leaves they are ready for a second transplantation, in the course of which they should be spaced with a distance of 6 inches between them in all directions. If they have to be transplanted again they should be moved with an interval of about a fortnight between successive moves. All plants should be especially well watered for a few days on transplantation.

49. As has been noted in paragraph 47, till plants are well established the soil around them should be kept firm and even. When the plants are established constant hoeing should be substituted. Hoeing not only removes weeds, which in competition with the crops rob them of nourishment, but by breaking up the surface of the soil it facilitates the passage of water to the roots and conserves the moisture in the soil and at the same time it admits air for the use of the roots. The operation should be repeated if rain or watering again consolidates a hard surface. An advantage of hoeing is to render more liable to attack by birds the grubs and

insects which shelter in the soil; it thus checks damage by pests. In hoeing and weeding, soil and growth between or immediately next to crops may be neglected if work on it is likely to disturb the plants.

50. By capillary action (para. 4) soil may lose 4 or 5 lbs. of water every day over each square foot of its surface. It is obviously of prime importance that such loss should be prevented. It can be prevented not only by hoeing, but also by mulching. This is the operation noticed above in paragraph 38, which consists in spreading on the surface of the soil a layer—leaves or litter, but sometimes sacks or matting—to thus prevent from being carried further moisture which capillary action has drawn up to the surface from below the ground.

51. For convenience of hoeing and in order to secure its more constant and effective application it is very advisable to sow or plant crops in drills or rows. It is better to sow in drills rather than broadcast and transplantation should of course take place into regular rows or lines. A minimum distance of 9 inches between drills or rows is convenient for effective hoeing.

52. A statement of the period which usually elapses between the sowing of a vegetable and its maturity can be only very approximate. The conditions which determine growth and maturity are liable in different localities and different gardens to very considerable variations. The notes below on different vegetables indicate approximately for each vegetable (except tomatoes, which must be sown under glass) sown in the open in time to mature without being subjected to winter conditions, what period on the average elapses between sowing and the earliest yield of produce fit for use. This average is greatly increased when vegetables remain in the

open throughout the winter, and it has in many cases been considerably decreased by the selective attention now devoted by seedsmen to the introduction into the market of varieties that mature quickly.

CHAPTER VIII

SUMMARY.

53. The preceding paragraphs may be summarized as impressing in all cases the necessity for attention to:

- digging thoroughly the soil in which vegetables are cultivated—para. 37;
- the need for humus—paras. 7, 13, 14, 24 and 35 (2);
- the use of lime—para. 15—and of salt—para. 25;
- the practice of rotation—para. 11—and of manuring—para. 12;
- sowing seed in soil worked very fine—para. 38;
- sowing seed thinly—para. 39;
- keeping seed-beds and seedlings moist—para. 42;
- thinning out seedlings drastically—para. 43—or transplanting them with care—paras. 44-46 and 48;
- sowing or planting in drills or rows—para. 51;
- keeping the soil round young plants firm and even—para. 47;
- hoeing constantly around established plants —para. 49; and
- watering regularly—para. 9.

54. With these essentials of good cultivation impressed on the mind for constant remembrance and practical application, we can now go on to deal

with the detailed characteristics and culture of the vegetable crops that are most commonly grown and are most in demand, as well as of small fruit. But the notes below do not describe different vegetables or fruits and do not discuss the varieties which it is best to grow. Varieties are now very numerous, and an up-to-date selection can be made only from experience or from reference to a good nursery gardener's catalogue.

55. The notes below deal in the following order with :

VEGETABLES :—

Beetroot ;
the common characteristics of the Brassica family ;
Broad Beans (leguminous) ;
Broccoli (Brassica family) ;
Brussels Sprouts (Brassica family) ;
Cabbages (Brassica family) ;
Carrots ;
Cauliflowers (Brassica family) ;
Celery ;
French Beans and Scarlet Runners (leguminous) ;
Jerusalem Artichokes ;
Kale (Brassica family) ;
Kohl-Rabi (Brassica family) ;
Leeks ;
Lettuce ;
Onions ;
Parsnips ;
Peas (leguminous) ;
Potatoes ;
Radishes ;
Spinach ;
Tomatoes ;
Turnips and Swedes (Brassica family) ;

HERBS :—

Mint ;
Parsley ;
Sage ;
Thyme ;

SMALL FRUITS :—

The common characteristics of Currants, Gooseberries, and Raspberries ;
Black Currants ;
Currants, Red and White ;
Gooseberries ;
Raspberries and Loganberries ;
Rhubarb ; and
Strawberries.

CULTURAL NOTES

VEGETABLES.

Beetroot : *Beta Vulgaris.*

Not hardy enough to withstand any exposure to frost. There are two varieties, the turnip rooted and the tap rooted, both excellent vegetables, either boiled or baked.

Prefers an open situation.

Prefers a light loam—para. 8 ; heavy or poor soil may give it an earthy flavour ; deep digging—para. 37—is essential because without it the roots may fork ; in unsuitable soil may be grown in a series of holes about 18 inches deep made with a crowbar and filled with suitable soil.

Prefers a moderate amount of lime—para. 15— in the soil.

Being originally a native of the seashore specially requires salt—para. 25.

Farmyard manure—para. 13—should not be used fresh ; requires land rich with the effects of such manure liberally applied for a crop that has preceded it.

Apply artificial fertilizers as recommended in para. 35 ; but, as an exception to what is noted in para. 34, for this crop half an ounce of a nitrogen fertilizer—para. 18—may with advantage be dug into each square yard just before sowing.

When the seedlings are fairly up and before the plants have passed well out of the seedling stage one or two waterings may be given with a nitrogen fertilizer—para. 35 (5); when the roots have formed the application of liquid manure from above may do harm by encouraging the growth of side shoots from the roots.

Cultivated from seed of which one ounce will suffice for a row of 50 feet.

Seed germinates—para. 41—in 10 to 20 days but may fail in soil that is not very fine.

The turnip rooted variety is fit for use—para. 52—in about 3 months and the tap rooted variety in about 6 months.

Sow the turnip rooted variety in the open in April and the tap rooted variety in May with successions till the end of June.

Quick maturing varieties may be sown in July for a late crop.

Sow 1½ inches deep in drills.

The drills should be 15 inches apart.

Will not stand transplantation—para. 44.

Thin out—para. 43—to 9 inches between plants unless large roots are required, in which case the distance should be greater.

Does not in ordinary conditions require to be specially watered.

The roots may be left in the soil to be dug up for use as wanted, but it is preferable to take them up after the end of October, and to store them in dry sand in a sheltered place protected from frost; in digging and storing the roots care must be taken to ensure that they are not injured or allowed to bleed; before storing the roots their leaves should be removed, but not by cutting them off as this may cause bleeding; the leaves should be twisted off a little way above the crown of the roots: will last in store for a very long time.

Brassica.

Broccoli, Brussels Sprouts, Cabbages, Cauliflowers, Kale, Kohl-Rabi and Turnips are all members of the Brassica family, and certain characteristics shared by them all—with an exception to some extent in the case of kohl-rabi and turnips—may conveniently be noted in common.

An enemy of the Brassica family that must be feared is club root, and in growing all members of this family every precaution against this disease should be taken. All members of the family are especially liable to be attacked by it and it is very common and very destructive.

All members of the Brassica family do best in an open situation but can be grown quite well in partial shade.

All do best in good loam—para. 8—and all do well in any ordinarily good garden soil if it is well manured and kept firm. Deep digging—para. 37—is essential and it reduces the risk of club root.

Lime—para. 15—must be very liberally applied; it is the most effective remedy for club root and this disease will probably show itself and destroy the crop unless the soil has lime enough to neutralize all its acidity. In cases where the disease is very bad as much as 1 lb. of ground lime may occasionally be needed for each square yard of garden.

Salt—para. 25—is required by the Brassica family which was originally a resident of the seashore; salt particularly improves soil of a light or medium consistency.

Wood ashes—para. 27—are especially useful in the cultivation of the Brassica family as they afford a check on insect pests.

Generally speaking the soil cannot be too rich for any member of the Brassica family.

If farmyard manure—para. 13— is used it should be applied very liberally and it may be used even in a fresh state; the digging in of green manure is also beneficial.

Apply artificial fertilizers as recommended in para. 35.

Members of the Brassica family make a great demand for a nitrogen fertilizer—para. 35 (5)—in all stages of their growth except the earliest. Turnips however, do not conform with what has just been said; in their case nitrogen fertilizers cannot well be applied during growth and, notwithstanding what is said in para. 34, half an ounce per square yard of a nitrogen fertilizer may with advantage be dug in just before turnips are sown. All members of the Brassica family are gross feeders and require very liberal stimulation; quick growth in their case is essential because it enables them to grow out of reach of pests and because it also ensures them against being hard and stringy. For all except turnips, as soon as the seedlings are well established begin regular waterings with a nitrogen fertilizer and except in the winter when there is no activity of growth continue these waterings till the plants mature. If there is any tendency not to heart or form heads or sprouts an eighth of an ounce of superphosphate of lime may in the later waterings be added to each gallon of the nitrogen fertilizer.

All members of the Brassica family are cultivated from seed of which a quarter of an ounce will suffice for a row of 50 feet.

Seed germinates—para. 41—in 8 to 10 days.

Seed should be sown—para. 38—shallow in heat and ½ inch deep in the open.

Kohl-Rabi and turnips should be sown in drills and matured where they are sown, but other members of the Brassica family should be sown in pans or seedbeds and transplanted—paras. 44-46 and 48—before being put out into the positions in which they are finally to mature, at least 2 transplantations being in all cases advisable, while 3 or even 4 improve cauliflowers and broccoli.

Whenever they are transplanted special precautions should be taken to examine all members of the Brassica family for club root and every plant that shows any sign of disease should promptly be removed and burnt so as to decrease the chance of the spread of the infection.

When any members of the Brassica family are transplanted it is particularly important that the soil to which they are transplanted or in which they are finally matured should be firm—para. 47. At the time of transplantation and during growth earth should be carefully pressed or trodden in around their roots and as they make growth the earth around their roots should from time to time be gathered around them and made firm so as to afford their stems a support which benefits their growth. Winter broccoli in particular requires a firm soil and it should be planted out into soil as firm as can be got—preferably into soil that has not been dug up recently.

For kohl-rabi and turnips notes regarding drills are given below in the memos. dealing with these crops; other members of the Brassica family should be planted out to mature in rows. The average distance between rows should be 2 feet and that between plants in the rows should also be 2 feet. But with such varieties as cauliflowers and broccoli which have an exceptionally spreading habit the distances between rows and between plants may be increased to 3 feet, while for small varieties such as early cabbages they may be decreased to 18 inches. Appropriate distances should be fixed according to the size usually attained by the particular variety which is being planted out.

Broad Bean: *Vicia Faba.*

An excellent vegetable, more nutritious than wheat.

Prefers a sunny situation.

Prefers a stiff loam containing clay—para 8; does well in any good garden soil; in light soil it is more liable to attack by the aphis of black blight; early crops, if grown, should have a lighter and richer soil than late crops.

The soil should have a liberal supply of lime—para. 15.

Farmyard manure—para. 13—if used, should be applied liberally.

Apply artificial fertilizers as recommended in para. 35.

After the plants are established—but only if needed and only very seldom—water with a nitrogen fertilizer—para. 35 (5); does not require much nitrogenous stimulant.

Cultivated from seed of which half a pint will suffice for a row of 50 feet.

Seed germinates—para. 41—in 12 to 14 days.

Fit for use—para. 52—in about 5 months.

May be sown in January or February either in slight heat for planting out when the seedlings have made some growth or else directly in the open.

The usual practice is to make successive sowings in the open during February, March and April.

For a very early crop seed may be sown in the open in October or November and wintered in the open with some protection against severe weather; sufficient protection is afforded by inverting a large flower pot over each plant.

Seed before being sown may be soaked for about 3 hours in warm water and then dried.

Sow in drills, 3½ inches deep, and with a distance of 4½ inches between seeds.

The drills should be 3 feet apart.

Stands transplantation—para. 44—but only if it is very carefully effected and does not benefit from it—para. 45.

Thin out—para. 43—to a distance of 9 inches between plants.

When the plants are about 4 inches high and thereafter from time to time as necessary earth should be gathered up around their roots.

When about five clusters of blossoms have set on each plant pinch off two or three inches from the tips of the plants; this not only tends to remove and thus check the black aphis which attacks broad beans, but it also encourages the development of pods.

As soon as any plant has finished cropping it should be rooted out; if left in the ground it may throw up suckers and unnecessarily exhaust the soil.

Broccoli: *Brassica Asparagoides.*

For notes regarding situation, soil, manure, sowing, transplantation, planting out and other matters common to the Brassica family, see Brassica.

The broccoli is a hardy variety of cauliflower which supplies heads from the end of autumn to the end of May and even to the end of June.

Prefers a strong soil with a considerable element of clay.

Fit for use—para. 52—in about 8 months.

May, for autumn use, be sown in slight heat in February or later.

May be sown for autumn and winter use in the open during April in soil which is thoroughly manured and very rich.

May be sown for winter and spring use in the open during April and May; the soil should not be very rich; plants brought up in very rich soil become too tender to resist frost well, while those brought up in soil that is not too rich are able to withstand frost.

Autumn broccoli should be finally planted out in June, and winter and spring broccoli should be finally planted out in July and August.

In the South of England broccoli may be allowed to stand in the ground as grown till required for use, but where the weather is severe the plants may, as a protection from frost, be turned up in November with a spade and arranged so that their heads, protected by litter, slope towards the North. A spadeful of earth should be removed from about the roots of each plant on its North side and the plant should then be bent over towards the North and the soil thrown up so as to cover its roots and then trodden in and made firm. The head will thus be shaded from the sun which would damage it if it shone directly upon the head after it had been frozen. Bent over from the sun the plant develops better than when left standing with its head fully exposed to the action of the sun.

Brussels Sprouts : *Brassica Gemmata Bullifera.*

For notes regarding situation, soil, manure, sowing, transplantation, planting out and other matters common to the Brassica family, see Brassica.

The Brussels sprouts is a variety of Brassica in which all the leaf buds are active and form heads. The sprouts are miniature cabbages formed in the axils of the leaves. The plant is very hardy and productive from November to March ; it is improved by frost which makes the sprouts tender.

Does well in fairly light soil.

Fit for use—para. 52—in about 9 months.

As the longest possible period of growth is required for the best results, seed may be sown in heat in January or February for planting out in March or April.

Is usually sown in the open about the middle of March (when sowings may also be made in heat) so as to get seedlings which can be planted out into very firm soil in May and become thoroughly established before the onset of the cold weather.

May also be sown in the open at the end of May.

From the end of the summer onwards all decaying leaves should be removed regularly ; they should be cut—not pulled—off.

The sprouts should be gathered before the head is cut, for the cutting of the head tends to cause the bursting of the sprouts and to stop the formation of further sprouts, while in severe weather it may also expose to injury such sprouts as are already on the plant.

The lowest sprouts should be gathered first ; as soon as the sprouts attached to the side leaves have been gathered the leaves should be removed by being cut off ; if these leaves are removed without injury to the plant greater regularity in producing sprouts is induced.

Cabbage : *Brassica Capitata.*

For notes regarding situation, soil, manure, sowing, transplantation, planting out and other matters common to the Brassica family, see Brassica.

The cabbage is a variety of Brassica in which only the terminal leaf is active and forms a head. Though without any very great food value, the cabbage is very useful as an antiscorbutic and because it is available in the winter when vegetables are scarce; but it should be remembered that unless it is fresh and tender when eaten it is somewhat difficult to digest and may cause flatulence.

Prefers a stiffish soil containing clay.

Is fit for use—para. 52—in as little as 4 months in the case of the summer varieties but in not less than 8 or 9 months in the case of varieties that mature in the spring.

Four sowings are often made, viz:—

(1) In heat in February, for planting out in April and use in the summer.

(2) In the open at the end of March, for planting out in June and use in August.

(3) In the open in April and May, for planting out in July or later for use in the autumn and winter; and

(4) In the open from the end of July to the end of August, for planting out in September or later for use in the spring.

Cabbages after their hearts are removed will, if a few of their lower leaves are left, produce as side shoots small heads and sprouts that are excellent for use; hardy plants may continue to produce these for long periods.

A cabbage cut with a stalk 3 or 4 inches long, of which the pith is removed without injury to the outside of the stalk, will keep fresh for a month or more if it is hung up by the stalk and the hollowed-out part of the stalk is kept constantly filled with water.

Carrot: *Daucus Carota.*

Prefers an open situation.

Prefers a rich deep sandy loam—para. 8; in soil that is heavy or has stones or clods in it the roots are apt to fork; in unsuitable soil can be grown in holes about 18 inches deep made with a crowbar and filled with suitable soil; in order to check the pests by which it is attacked the soil in which it is grown should be kept always firm and even—para. 47.

Requires a fair amount of lime—para. 15—in its soil.

The treatment of its soil with wood ashes—para. 27—is beneficial.

If farmyard manure is used—para. 13—it should have been applied heavily for a crop that precedes the carrot which does not like such manure freshly applied.

Apply artificial fertilizers as recommended in para. 35;

but, as an exception to what is noted in para. 34, for this crop an ounce of nitrogen fertilizer may with advantage be dug into each square yard just before sowing; manure applied to carrots during growth may cause forking of the roots but the crop requires well-enriched soil which will encourage quick growth and so enable it to grow quickly out of the reach of the insect pests which affect it and will also ensure tender roots. A nitrogen fertilizer should not be applied during growth.

Cultivated from seed of which one ounce will suffice for a row of 50 feet.

Seed germinates—para. 41—in 12 to 18 days.

Fit for use—para. 52—in about 4 months in the case of early varieties and in up to as much as 6 months in the case of late varieties.

Can be sown in the open in March.

The usual practice is to sow early varieties in the open in April and to follow with later varieties of which the sowings can be continued till the end of July.

Quick-maturing varieties can be sown in August or later.

The seeds have hooks or projections and they must, in order to secure even sowing, either be sown mixed with dry earth or else after having their projections removed; to remove the projections the seeds should be rubbed together in dry sand or earth; seeds are usually sold after their projections have been removed.

In order to hasten germination seed may before being sown be soaked in warm water.

Sow shallow—para. 38—in drills.

The drills for early varieties should be 6 inches apart, and for late varieties 12 inches.

Will not stand transplantation—para. 44.

Thin out—para. 43—in the case of early varieties to a distance of 6 inches between seedlings and in the case of late varieties to a distance of 9 inches.

Does not in ordinary conditions and in good soil require much watering but must be kept moderately moist.

Carrots taken up after they have matured can be kept for an indefinite period if stored in dry sand or ashes in a dry cool place.

Cauliflower : *Brassica Cauliflora.*

For notes regarding situation, soil, manure, sowing, transplantation, planting out, and other matters common to the Brassica family, see Brassica.

The cauliflower is a variety of Brassica in which the terminal leaf is alone active and open with most of the flowers succulent and abortive. It is the most tender member of the Brassica family and cannot stand frost.

Prefers a soil of medium texture.

Fit for use—para. 52—in about 5 months.

For an early crop sowings can be made at the end of August; the seedlings should be brought up in poorish soil in order to keep them hardy and they should be wintered under glass till they are planted out in April or May into very rich soil. But plants raised from seed sown in slight heat in January are ready nearly as early.

For a crop in July and August sow in slight heat in January, February or the beginning of March and plant out the seedlings at the end of April or later.

The usual practice is to sow in the open from the end of April to the beginning of May and to plant out the seedlings in June or later for a crop in September or October.

If the seedlings are allowed during the process of transplantation to develop considerably before they are finally planted out their heads will probably be small; small heads are often preferred.

Early heads can be obtained by using pots for the final transplantation and maturing the plants in the pots under glass.

The removal of the lower leaves assists in the production of heads.

The best heads are those which are cut in the early morning with the dew still on them.

The stems should be removed from the ground as soon as their heads have been cut off.

If a number of cauliflowers are ready for use and are not wanted at once they can be kept if they are taken up with large balls of earth around their roots; if it is desired to keep them for only a week or so they should be hung up by their roots (from which the earth should not be removed) in a dry dark place and they should be syringed daily; if it is desired to keep them for considerable periods, they should be put (with the earth still attached to their roots) in pots which should be kept in a sheltered place and protected by mats or sacking from the frost, most of the leaves being removed from the plants which should be so arranged that they do not touch one another.

Celery: *Apium Graveolens.*

Prefers a sunny situation; is improved by exposure to frost when it is fully grown.

Prefers a medium loam—para. 8.

The soil should be liberally treated with lime—para. 15.

Salt—para. 25— is specially required by celery.

If farmyard manure—para. 13—is used it must be applied very liberally; such manure can be given fresh and cannot be given in excess; it is wanted in the seedbeds, during transplantation, and in the trenches, being usually dug in to the trenches just before the plants are finally put out into them.

Apply artificial fertilizers as recommended in para. 35.

Celery is a gross feeder and should be given waterings with a nitrogen fertilizer—para. 35 (5)—once a week from the time of first transplantation up to the time when the blanching process commences.

Cultivated from seed of which an eighth of an ounce will suffice for a row of 50 feet.

Seed germinates—para. 41—in 15 to 20 days.

Fit for use—para. 52—in about 7 months.

Usually sown in heat in February, March and April; a temperature of at least 65° F. is required for germination, but as soon as the seedlings have made their appearance the heat may be reduced.

May be sown in the open about the middle of April and later, provided that the seed bed is protected against any unusual cold.

Sow shallow—para. 38—in seed pans and cover with a thin layer of sand.

Seedlings must be kept constantly moist.

Should be twice transplanted before planting out—paras. 44–6 and 48—but especial care must be taken not to injure the roots as celery never recovers from a check to its growth.

At the second transplantation and at the time of final planting out the tops of the seedlings may be shortened in order to get stocky plants.

The time of sowing should be regulated with reference to the time at which the seedlings are to be finally planted out so as not to allow them to develop considerably during transplantation, because if they are too developed before final planting out, they are liable to bolt.

Plant out for the earliest crop in the beginning of June and follow with successional plantings out.

Plant out into trenches 8 inches deep, 12 inches wide and 3 feet apart, with the plants 1 foot apart in the trenches.

The trenches should run North and South so as to secure the maximum effect of sunlight, and they should be dug only just before the plants are put into them so as fully to conserve their moisture.

The soil of the trenches should be kept even and firm—para. 47.

The plants must be watered liberally till blanching begins.

Blanching should begin when the plants are about 18 inches high—usually in the period from September to November, according to whether the crop is early or late.

The blanching process gradually stops further growth and requires about 6 or 7 weeks for its completion.

Two blanching systems are noted below: the first—earthing up—is usually followed, but the second—paper blanching—is the more effective.

In both systems the first step is to remove all broken and short leaves and all side shoots and suckers about the roots of the plants.

In both systems care must be taken to prevent earth from getting into any plant between its stems.

In the first system:

Draw the earth up around the bottom 6 inches of the stems and make it firm and as the plants make growth make similar successive drawings up of the earth, each of the later drawings up being of a depth of 3 or 4 inches.

In the second system:

Surround the bottom 6 inches of the plants with bands of tough paper tied with string or raffia, then draw earth up to the paper and make it firm, following with a succession of similar paperings, each of 3 or 4 inches in depth and with the earth drawn up to them.

In both systems the special process—earthing-up or paper-covering—must be continued till the stems of the plants are completely covered and the coverings have reached up to the leaves of the plants.

French Bean: *Phaseolus Vulgaris.*

Scarlet Runner: *Phaseolus Multiflorus.*

Both are very nutritious; French beans are also known as kidney beans, and their dried seeds as haricot beans.

Prefers a sunny situation and as it is somewhat tender the situation must be sheltered.

Prefers a light dryish loam—para. 8—but yields good crops on any good garden soil, and even on poor soil if it is dug deep; has an extensive root system for which the soil must be prepared by deep digging—para. 37.

Only a little lime—para. 15—is required.

Salt—para. 25—is beneficial and should be well applied.

If farmyard manure—para. 13—is used it should be applied liberally.

Apply artificial fertilizers as recommended in para. 35.

Gives the best results when made to grow with rapidity and vigour, and should have one or two waterings of a nitrogen fertilizer—para. 35 (5)—when the seedlings are fairly well up and similar waterings every week after the pods form.

Cultivated from seed of which half a pint will suffice for a row of 50 feet.

Seed germinates—para. 41—in 10 to 12 days.

French beans are fit for use—para. 52—in about 3½ months, and scarlet runners in about 4 months, but in the case of dwarf varieties the period is often less.

The French bean may be sown in slight heat in April and planted out when it has made some growth.

Bearing in mind that the seeds of Phaseolus make little progress in soil of which the temperature is under 45° F., the usual practice is to make successive sowings of French beans from the end of April to the end of June (later sowings being liable to damage by frost), while scarlet runners being more tender than French beans follow them and usually are not sown till May.

French beans may also be sown in the autumn in slight heat and wintered under glass.

Seed before being sown may be soaked for about 3 hours in warm water and then dried.

Sow in drills, about 2½ inches deep, with a distance of 4½ inches between seeds.

The drills should be from 2 to 3 feet apart according to the height of the variety sown.

Thin out—para. 43—to a distance of 9 inches between seedlings.

Stands transplantation—para. 44—but only if very carefully effected and does not benefit from it—para. 45.

Sticks for their support should be put in when the plants are about 1 foot high ; the best plan is to put in sticks on both sides of rows and to tie their tops together.

All varieties can be grown with short supports, if, in the case of the tall varieties, their main shoots are pinched off when the plants are 18 inches high, and pinched again when they have made another 18 inches of growth, side shoots being at the same time pinched off when they are 6 inches long ; but if they are allowed to develop to their full height tall varieties require sticks 6 or 7 feet long.

The Phaseolus twines in a direction contrary to the apparent motion of the sun ; accordingly in attaching its twining shoots to a support they must be trained from right to left, or else they will not hold.

As soon as flowers are being produced freely, to pinch off the point of each shoot will encourage the early formation of pods.

The Phaseolus is not very greedy for water but it must be watered in moderation, particularly if there is any tendency for the pods to fall off; in hot weather water should be given freely and if the water given is tepid this will help the plants to form pods.

The Phaseolus benefits from plenty of overhead moisture and it should be constantly syringed; syringing checks the falling off of flowers and helps the flowers to form pods.

The pods are ready for use when on being bent they snap off easily; but they should not be torn off; they should be cut off neatly, for injury caused to the plants by the tearing off of pods will check their productiveness.

When the pods are ready they should be gathered at once and with regularity, for if they are gathered other pods form, whereas if they are not gathered and seed is allowed to set in them the formation of other pods ceases.

Jerusalem Artichoke: *Helianthus Tuberosus.*

A variety of sunflower; with tubers rich in sugar.

Prefers a sunny situation but does well in partial shade.

Prefers a light friable deep loam—para. 8—but succeeds on any fair garden soil, even on poor soil, if dug deep—para. 37.

Does not require much lime—para. 15—but should have a little.

If too liberally manured runs to stalk and leaf at the expense of tuber, but profits from moderate treatment with farmyard manure—para. 13.

Apply artificial fertilizers as recommended in para. 35.

But little nitrogen fertilizer is wanted and a few waterings —para. 35 (5)—will suffice.

Can be cultivated from seed sown in slight heat in March.

Usually cultivated by the planting of tubers of which 5 lb. will suffice for a row of 50 feet.

Fit for use—para. 52—in about 9 months.

Plant in February or March.

The least rugged tubers should be selected for planting and each tuber should have one or two eyes.

Plant in rows about 6 inches deep or in heavy soil somewhat less and with a distance of 1 foot between tubers.

The rows should be 3 feet apart.

As the plants grow draw soil up around their stems.

In August cut off the stems about their middles.

The tubers, even if not quite mature, can, if required, be taken up and used in September or later.

As soon as the stems have withered completely the tubers can be taken up and stored in sand, or else, since they are not hurt by frost, they can be left in the soil and dug up from time to time as required for use.

After a crop, carefully remove all traces of tubers, for any left will cause trouble later by sprouting.

Kale (Borecole) : *Brassica Fimbriata.*

For notes regarding situation, soil, manure, sowing, transplantation, planting out and other matters common to the Brassica family, see Brassica.

Kale is a variety of Brassica in which all the leaf buds are open and active ; it is very hardy and in firm soil will without difficulty come through snow and frost, which indeed improve it.

Succeeds in all ranges of soil from heavy to poor, but prefers soil of a medium texture.

Fit for use—para. 52—in about 8 months.

Sow in the open in the beginning of April so that the plants may be established and hardened before the onset of the winter ; sowings may be continued till May.

The seeds may, to protect them from being devoured when in the ground, be soaked in paraffin oil, but they must not be kept in the oil for more than a few minutes, or else their vitality will suffer.

The lower leaves should be stripped off for use as the plants grow up.

When the heart is used only so much of it should be cut out as is fresh and tender.

Side shoots are produced for a long time in succession and these can be used as long as they are tender enough to be snapped off from their parent stem.

Kohl-Rabi : *Brassica Caulo-rapa.*

For notes regarding situation, soil, manure, sowing, and other matters common to the Brassica family, see Brassica.

Kohl-Rabi is a variety of Brassica which develops between the root and the leaves a bulb that can be treated like a turnip ; exceedingly hardy and able to resist both frost and drought.

Prefers a stiffish loam.

Fit for use—para. 52—in about 4 months.

Usually sown in the open in May with successional sowings till the end of June.

Sow half an inch deep in drills.

The drills should be 18 inches apart.

Stands transplantation but is not improved by it—paras. 44-45—and should not be transplanted.

Thin out—para. 43—to a distance of 12 inches between plants.

The roots should not be earthed up or the leaves in any way damaged.

Leek : *Allium Porum.*

A very wholesome vegetable ; hardy and stands frost well ; no vegetable stands the sea air so well or keeps so well at sea.

Prefers a sunny situation.

Prefers a light deep soil—para. 8.

Should have a moderate supply of lime—para. 15.

Farmyard manure if used—para. 13—may be either fresh or that left in the soil by a preceding crop which has been heavily manured.

Apply artificial fertilizers as recommended in para. 35.

The leek is a gross feeder and is the better for quick growth ; give weekly waterings with a nitrogen fertilizer—para 35 (5)—from the time of planting in trenches till earthing up renders watering no longer convenient.

Cultivated from seed of which a quarter of an ounce will suffice for a row of 50 feet.

Seed germinates—para. 41—in 7 to 10 days.

Fit for use—para. 52—in about 9 months.

Is improved by a long growing period and may be sown in heat in January or February to plant out in April or May.

Usually sown in the open as soon as weather conditions permit and not later than May.

Before being sown the seeds may be soaked in warm water for 12 hours.

Sow shallow—para. 38—in pans or seedbeds.

Transplant—para. 48—at least once before planting out.

Plant out into trenches 9 inches deep and 9 inches wide and 2 feet apart with a distance of 6 inches between plants.

In planting out each root with the ball of earth taken up with it intact should be placed in a hole made with a dibber and the hole should not be filled up but left with room for the swelling of the stem.

In order to secure adequate blanching plant at least 3 inches deep.

Water freely in dry weather.

As the plants increase in size draw earth up around their stems.

To make the necks swell cut off the tops of the leaves every month as new leaves are produced.

As the flower stems appear they should be pinched off ; this will result in the growth on the roots of offsets which are known as leek bulbs and can be used like onions.

The leek should remain in the ground during the winter and should be dug up for use as required.

Lettuce : *Lactuca Sativa.*

Two varieties are grown, the Cos (Lactuca Romana) and the Cabbage (Lactuca Capitata); both are summer or winter crops but the former is the better summer variety and does best in the summer.

Prefers an open situation but does well in partial shade.

Prefers a light loam—para. 8 ; in poor soil the cabbage variety does better than the cos.

Should have a moderate supply of lime—para. 15.

If farmyard manure is used—para. 13—it should be applied liberally though the top soil should not be so heavily manured as the soil underneath.

Apply artificial fertilizers as recommended in para. 35.

Rapid growth is essential for good plants and the liberal application of a nitrogen fertilizer—para. 35 (5)—is appropriate, waterings being given weekly from the time when the seedlings are well established.

Cultivated from seed of which a quarter of an ounce will suffice for a row of 50 feet.

Seed germinates—para. 41—in about 8 days.

Fit for use—para. 52—in 10 to 12 weeks.

May be sown as early as January in pans under heat to be matured under heat or else planted out if the weather permits.

Usually sown in the open from March onwards even up to August.

May also be sown under heat in the autumn and matured under glass or after being wintered under glass planted out as early as possible in the spring.

Sow shallow—para. 38—in drills.

The drills should be one foot apart.

Thin out—para. 43—to a distance of 1 foot between plants.

Stands transplantation—para. 44—but transplanted lettuces do not grow so quickly or attain so fine a growth as those that have not been transplanted ; transplantation, however, checks the bolting or running to seed which is somewhat characteristic of lettuces and seedlings removed in the course of thinning out can with advantage be used to fill up blanks or to plant in an additional row.

Lettuces want copious watering immediately after they have been transplanted, but those that are grown without transplantation want only moderate watering, though the watering should be regular.

Cos lettuces may be grown in varieties of which the leaves naturally fold together so as to form a blanched heart without tying up, and in other varieties of which the leaves naturally open out and must be tied together in order to secure blanching. Water or liquid fertilizers should not be applied so as to reach the heart, which, if damp, may rot; water or liquid fertilizers should be applied at the side of the plants.

In the case of lettuces which are tied up for blanching, if at the time of tying them up the central bud of the plants can conveniently be removed, its removal will prevent the plants running to seed.

Onion: *Allium Cepa.*

Prefers a light sandy soil—para. 8, but the soil must be very firm—para. 47; this is especially important.

It is important to treat the soil with a fairly liberal supply of lime—para. 15.

Soot—para. 26—is especially beneficial for onions.

If farmyard manure is used—para. 13—it should be applied very liberally but it is advisable to dig it in some time before the crop is sown or planted out as if the manure is too stimulating it may produce bottle neck.

Apply artificial fertilizers as recommended in para. 35.

Water with a nitrogen fertilizer—para 35 (5)—every week for 6 weeks after the plants have been planted out or finally thinned; if the waterings are continued longer there is a risk that the bulbs will split.

Cultivated from seed of which a quarter of an ounce will suffice for a row of 50 feet.

Seed germinates—para. 41—in 7 to 10 days.

Fit for use—para. 52—in about 6 months.

May be sown in slight heat in February or later for planting out as soon as the weather permits.

Usually sown in the open in March and April.

May also be sown in August or later either in seedbeds in the open or else in slight heat for planting out in the spring.

It is preferable to sow shallow—para. 38—in pans or seedbeds and to transplant—para. 48—as the onion improves by transplantation—para. 45—and a better crop less liable to attack by insects is obtained if the seedlings are transplanted once or twice before being planted out; the largest bulbs are obtained from autumn sowings followed by transplantation in the spring.

Usually sown shallow—para. 38—in the open in drills. The drills should be 9 inches apart.

Before sowing the soil must be made very firm by rolling or treading down and it should be rolled or trodden down again after the seeds have been sown and covered over.

Thin out—para. 43—to a distance of 9 inches between seedlings; the distance between plants for planting out is also 9 inches.

In transplanting or planting out the roots only should be put into the ground and no part of the stem should be buried—para. 46; does best with the bulb resting on the ground; if any part of the stem is under ground it will probably form a bottle neck.

After transplanting or planting out care must be taken to make the soil even, firm and hard as this hastens the formation of bulbs.

Requires water in moderation and considerable water in dry weather; but watering should not be continued after the bulbs have attained a fair size, for after that it checks their further growth.

To get large bulbs pick out the flower buds as soon as they appear.

In July bend over the stems so that they lie flat on the surface of the ground; the bend should be made 2 inches up the neck with care to avoid breaking the plants; breaking the leaves checks further development of the bulbs, but bending them over without breaking encourages the bulbs to grow in size and discourages the production of more foliage.

Withering of the leaves indicates ripening and when their leaves are withered onions should be taken up, dried and stored; they can be tied together in bunches by their leaves and kept hanging upside down in a place protected from damp and frost.

Parsnip: *Pastinaca Sativa* (*Peucedanum Sativum*).

A valuable vegetable, rich in sugar and nourishing substances hardy; its flavour is improved by exposure to frost.

Prefers an open situation but does well in partial shade.

Prefers a sandy loam—para. 8—which must be dug deep—para. 37—since the parsnip is very deep rooted; in soil that is heavy or that contains clods or stones the roots fork; in unsuitable soil can be grown in holes 18 inches deep made with a crowbar and filled with suitable soil.

The flavour is best when grown in soil containing lime—para. 15—which should be applied with moderate liberality.

Wood ashes—para. 27—are also of benefit.

If farmyard manure is used—para. 13—it should be applied deep and not on the surface ; if applied too heavily or too recently it spoils the flavour and develops side roots.

Apply artificial fertilizers as recommended in para. 35, but as an exception to what is noted in para. 34, half an ounce of a nitrogen fertilizer may with advantage be dug in to each square yard just before sowing.

Water with a nitrogen fertilizer—para. 35 (5)—when the plants have made fair growth but only occasionally and only at a distance from the roots which otherwise may fork ; quick growth is necessary not only to give tender roots but also to assist the plants to resist the attacks of pests.

Cultivated from seed of which half an ounce will suffice for a row of 50 feet.

Seed germinates—para. 41—in 15 to 20 days.

Fit for use—para. 52—in about 7 months.

Sow in March with successions to the end of April.

Sow half an inch deep in drills, dropping 2 or 3 seeds into holes made in the drills at distances of 1 foot between holes.

The drills should be 1 foot apart.

When the seedlings are about 2 inches high take out all but one from each hole in which the seeds were sown.

Will not stand transplantation—para. 44.

The roots should be left in the ground during the winter and dug up for use from time to time as required.

Pea : *Pisum Sativum.*

A highly nutritious vegetable, containing much protein, nitrogen, starch and sugar ; the varieties with wrinkled seeds have more sugar and a better flavour than the varieties with round seeds ; peas are self-pollinated and therefore are fertile without the assistance of insects or bees.

Prefers an open and sunny situation ; the rows in which peas are grown should run North and South so as to give both sides an equal exposure to the sunlight.

Prefers a friable loam—para. 8—but the soil must be well dug—para. 37—to a depth of at least 2 feet ; deep digging is essential as the roots should go directly downwards and unless they do so the plants may be stunted and suffer from mildew ; peas of different varieties range in height from 12 inches to 6 feet and dwarf varieties succeed in poorer and lighter soil than the taller varieties.

The free use of lime—para. 15—is essential for a good crop.

If farmyard manure is used—para. 13—it should not be applied near the surface and though the application should be liberal even the soil underneath should not be too rich as otherwise the roots will spread without going down straight as they should do for a good crop; the pea does best on farmyard manure left in the soil by a preceding crop which has been well manured.

Apply artificial fertilizers as recommended in para. 35.

Stimulants on the surface are not appropriate till the plants are strongly established; in the early stages of growth the application of a nitrogen fertilizer—para. 35 (5)—may do more harm than good; but, if necessary, a watering with such a fertilizer may be given when the plants are at least 6 inches high and occasionally after the pods have formed.

Cultivated from seeds of which 1 pint for the taller varieties to 3 pints for the dwarf will suffice for a row of 50 feet.

Seed germinates—para. 41—in 10 to 20 days.

Fit for use—para. 52—in from 12 to 24 weeks; the tallest and wrinkled-seed varieties take the longest periods while dwarfs and varieties with round seeds take the least and thus are very useful for successional sowings.

May be sown in January or later in heat for planting out as soon as the weather conditions permit.

Usually sown in the open with a beginning in February if the weather is favourable, though the main sowings are made in April and May; the varieties with round seeds being more hardy should be sown earlier than the wrinkled-seed varieties; for a succession a fresh sowing may be made as soon as a previous sowing is well above ground.

May be sown as late as July, quick ripening varieties being used for the latest sowings.

Before being sown seeds may be soaked in warm water for about 3 hours and then dried; seeds are liable to the ravages of birds and mice, and as a protection they may, before they are sown, be dipped in paraffin oil, but not soaked in it.

In light soils sow as much as 2 inches deep but less in heavy soils; sow in rows at a distance of from 1 to 3 inches between seeds, the distance being varied according to the height of the variety sown and being least for the shortest and most for the tallest variety.

The rows (which as already noted should run North and South) should be at a distance apart about equal to the height of the variety sown.

As a protection from birds and mice fix wire pea-guards over the rows.

If the seeds have been sown so that more than one plant comes up at the distances (1 to 3 inches) required, the surplus plants should be removed.

Stands transplantation—para. 44—but only if very carefully effected—para. 46—and does not benefit from it—para. 45; if germinated in pots should be transplanted by turning out of the pots the soil in which they grow without any disturbance of the soil or of the roots or any exposure of the latter.

When the plants are 3 inches high and thereafter from time to time gather up earth around their roots and tread it in firm.

Black cotton stretched over the rows on short sticks affords some protection against the attacks of birds.

All varieties require support as soon as their tendrils appear, though dwarf varieties mature more quickly if allowed to grow without support; branched twigs or sticks should be used as supports and put in opposite each other on both sides of each row of peas; with supports on one side only the plants fall over to the side which has no support.

Peas do not need much water except in dry weather or till they come into bearing when watering keeps the peas tender and checks their ripening; watering the leaves is injurious.

As soon as the plants are well in blossom their leading shoots should be pinched off in order to concentrate the strength of the plants on the production of pods.

The pods should be gathered as soon as they are ready for use; if they are left on the plants and allowed to get at all dry, the further production of pods ceases, while the regular picking of the pods as they come ready increases pod production.

In the gathering of the pods care should be taken not to injure the plants; if the pods are cut off with scissors the crop may be as much as a quarter more than it would be if the pods are torn off roughly.

Potato: *Solanum Tuberosum.*

Prefers a sunny situation but does well in partial shade.

Prefers a sandy friable loam—para. 8— and will not do well on soil that is mainly clay, chalk, sand or bog.

Does best on soil without much lime—para. 15—for while it does not itself require much lime, a considerable amount of this constituent is favourable for the development of the potato scab.

If farmyard manure is used—para. 13—it should be applied liberally some time before the crop is planted and it should be dug in deep, for potatoes should never be planted in direct contact with farmyard manure.

Apply artificial fertilizers as recommended in para. 35.

Extracts nitrogen from the soil and does not want much nitrogen fertilizer, but a watering with such a fertilizer—para.

35 (5)—may if necessary be given when the plants are 6 inches high, though this may be dispensed with if the plants show strong growth.

Cultivated by planting tubers or pieces of tubers each containing at least one eye; these pieces are called sets.

Fit for use—para. 52—in the case of early varieties in about 4 months and in the case of later varieties in up to 6 months.

If protected from frost may be planted in the open as early as February, but it must be borne in mind that potatoes cannot withstand any frost.

Usually planted in the open in March with a second planting in April.

May be planted as late as July if quick-growing varieties are used.

Tubers may be planted without first causing them to sprout, but by sprouting potatoes and making sets before planting the crop is increased by as much as 1½ or 2 per cent. in comparison with a crop obtained from tubers planted without sprouting. To prepare for planting tubers are, about 6 weeks before sets are required, placed in a single layer at the bottom of a shallow box and kept in moderate daylight in order that they may develop shoots; when shoots have developed the tubers should be cut into pieces or sets, each having one or two green shoots or eyes, and the rest of the shoots (in particular those that are white and of no value) should be rubbed off; the cut surfaces of the sets should be rubbed in lime and allowed to dry for a few hours; the sets are then ready for planting.

Plant from 4 to 6 inches deep in drills with a distance of 12 inches between drills for potatoes of moderate growers and a greater or less distance for more or less vigorous varieties.

Sets should be completely covered with earth but this should not be pressed down or made hard and it should be left fairly loose and made moist.

As potatoes cannot stand frost they should, in case frost threatens, be covered with litter.

Will not stand transplantation—para. 44.

Earth up when 6 inches high and again after another 6 inches of growth; this prevents the potatoes from becoming green.

Do not require to be watered except when seen to be suffering from drought.

If infected with disease before they are quite fit to take up, the haulms—the stalks and leaves—may be cut off and they should in that case be burnt.

Fit to lift when the haulms turn yellow.

Potatoes are liable to a number of special diseases; the most valuable remedy against them is care in the selection for planting of sets that are free from disease.

The effect of potatoes on weeds is interesting as an example of the necessity of light for vegetation. The top growth of potatoes is so heavy and close that it excludes light from the soil in which the crop is grown, and this exclusion of light prevents weeds from growing freely under potatoes grown closely together.

Radish : *Raphanus Sativus.*

Easy to grow and cultivated in a number of varieties—long, oval and turnip-shaped, and either crimson or white in colour. The long variety is best for forcing or for cultivation in the early spring or late autumn and the others are best for the summer.

Early and late sowings should have a sunny situation but in the summer the radish does well in partial shade.

Prefers a light sandy well-worked loam—para. 8.

Requires only a moderate amount of lime—para. 15.

If farmyard manure—para. 13—is used it must be applied some time before sowing and the soil should not be too much enriched with it.

Apply artificial fertilizers as recommended in para. 35.

Quick growth is essential for tenderness and succulence in radishes and they should be frequently watered with a nitrogen fertilizer—para. 35 (5).

Cultivated from seed of which half an ounce will suffice for a row of 50 feet.

Seed germinates—para. 41—in from 7 to 10 days.

Fit for use—para. 52—in about 3 weeks.

From October to February may be forced in frames or under glass at a temperature of about 60° F.

Sowings in the open may be made as early as February, but the seed beds and young plants may suffer from frost even if protected—see para. 38.

As the radish remains fit for use only a few days, for a regular supply, succession sowings should be made every ten days or so and these can be continued till the end of September.

Sow shallow—para. 38—in drills.

Drills should be at least 6 inches apart.

Thin out—para. 43 ; good roots cannot be obtained unless the distance between plants is so great that no two neighbouring plants touch each other with their leaves.

Will not stand transplantation—para. 44.

Water liberally in hot weather.

Spinach : *Spinaca Oleracea.*

A very healthy vegetable though not easy to cook in the form of a pureé which suits it best ; two varieties are usually grown, the Summer—Globosa, and the Winter—Spinosa.

Summer spinach should have mid-day shade but the winter variety should have a sunny situation.

Prefers a friable loam—para. 8—but does not find a very light soil quite suitable, though it will do well on a stiffish soil.

Requires only a moderate supply of lime—para. 15.

If farmyard manure is used—para. 13—the ground must be well enriched with it.

Apply artificial fertilizers as recommended in para. 35.

Must be grown luxuriantly in order to avoid the risk of bolting ; water with a nitrogen fertilizer—para. 35 (5)—after the plants are established and thereafter weekly.

Cultivated from seed of which half an ounce will suffice for a row of 50 feet.

Seed germinates—para. 41—in 10 to 16 days.

Fit for use—para. 52—summer spinach in about 3 months and winter spinach in about 4 months.

Summer spinach is sown in the open in the middle of March and as the crop lasts at its best for only a short time the first sowing is usually succeeded by small sowings at intervals of a fortnight up to August ; winter spinach is usually sown in the open in August and September.

Before being sown seed may be soaked in warm water for about 12 hours.

Sow 1 inch deep in drills.

The drills should be 1 foot apart.

Thin out—para. 43—to a distance of 1 foot between seedlings ; summer spinach must have at least this space in order to mature well, though winter spinach can do with less.

Will not stand transplantation—para. 44.

Summer spinach must be watered liberally, but the winter variety needs water only occasionally.

When summer spinach is ready, if a succession has been sown, the plants may be cut off close to the roots and the roots removed, though if there is no succession only the outer leaves may be plucked and the plants will then produce more leaves.

With winter spinach only the outer leaves should be picked and the centres of the plants should not be injured ; the plants may thus be encouraged to produce a succession of leaves, even up to the beginning of May.

Tomato: *Lycopersicum Esculentum.*

Must have full sunlight.

Prefers a light sandy loam—para. 8—resting on a basis of leaf mould; is grown best in pots or boxes, each box measuring about 9 inches each way.

Requires some lime—but not very much—para. 15.

Benefits from a liberal supply of salt—para. 25.

The use of farmyard manure—para. 13—usually produces too free a growth of foliage; its place is therefore taken by leaf mould which should be used very liberally under a layer of light soil.

Since excessive luxuriance in the early stages of growth is detrimental, artificial fertilizers are not mixed with the soil in which tomatoes are grown; but if they are applied after the fruit begins to set they are beneficial; tomatoes require more potash even than do potatoes; an appropriate mixture for them is 2 ounces of superphosphate of lime—para. 21—and 1 ounce of potassium sulphate—para. 23—dissolved in a gallon of water, to which may be added if necessary half an ounce of a nitrogen fertilizer—para. 18. But tomatoes do not require much nitrogen, and in fact, may do well without any; accordingly the nitrogen constituent suggested for the mixture may be reduced or omitted unless any necessity to stimulate growth is noticed. The mixture of artificial fertilizers used should be applied every week after the plants have begun to set fruit.

Cultivated from seed, which is sold either by weight or by count; half an ounce of seed will suffice for 1,000 plants and with high-class expensive varieties it is better to buy the seed by count; seed may be obtained from fruit allowed to get thoroughly ripe on the plant; seed taken from such fruit should be dried and may then be kept till required for sowing.

Seed germinates—para. 41—in 10 to 12 days.

Fit for use—para. 52—in about 3 months.

Usually sown in pans in February in a heat of 65° F., with later sowings which may be continued till June.

Sow shallow—para. 38.

Keep the seedlings moist—para. 42—but do not at first water too liberally as seedlings in their early stages suffer from excessive watering.

Whether matured under glass or in the open, seedlings must be transplanted—para. 48—at least 3 times under glass into pots or pans and the soil in which they are reared must at all times be kept quite firm and even.

To mature under glass plant finally in very large pots or in boxes of the size noted above.

In the positions in which the plants are finally to mature there should be a distance of 2 feet between plants.

Water sparingly till the fruit sets.

The uppermost roots are very shallow, just under the surface of the soil ; care must be taken not to injure or disturb them in any way, e.g., in removing weeds.

To get strong plants grow in a strong light and with the full benefit of the sun.

Train to one stem only, regularly and consistently pinching out side shoots as soon as they form in the axils.

From an early stage of their growth support the plants with stakes, and tie them from time to time to the stakes as their growth increases.

Pinch out the top of the main stem as soon as it is as high as is desired or as soon as the fruit sets; ordinarily the plants may be topped when 4 or perhaps 5 trusses of blossom have appeared.

Except when in flower syringe twice daily in dry weather.

To get the fruit to set it may be necessary when the plant is in flower to shake it by tapping it gently on the stem.

After the fruit sets water more freely than before ; give water whenever the plant commences to get dry ; but do not overwater ; slight dryness is preferable to saturation ; excessive moisture is likely to cause the fruit to split.

When the fruit has all set gradually remove leaves, commencing with those lowest down and any that cover any of the fruit too closely ; this opens the plant to light and air and assists the fruit to ripen and colour.

Any fruit that cannot conveniently be ripened on the plant can be plucked and placed in a warm room in a position in which it gets full sunlight and it will then ripen perfectly.

If the plants are to be matured in the open, the directions given above will apply, but it is necessary also to—

Plant out at the end of May or in June ;

Protect the plants till they are quite hardened to the open ;

Pinch out the main shoot when a score or so of fruit have set ; and

Pinch back the fruiting branches so as not to let them grow to any great length beyond the point where the fruit has set.

Turnip : *Brassica Rapa.*

For notes regarding situation, soil, manure, sowing and other matters common to the Brassica family, see Brassica.

The turnip is a variety of Brassica which develops a bulb at the top of the root ; the swede (Brassica Rutabaga) resembles the turnip and may be cultivated in the same way.

Prefers soil of an open texture ; succeeds in soil lighter than is required by other members of the Brassica family.

As noted under Brassica, turnips may have a nitrogen fertilizer dug in just before they are sown; during growth they do not benefit from liberal applications of such a fertilizer; 1 or 2 waterings for the seedlings, when established, will suffice.

If turnips show any tendency not to bulb, they, like other members of the Brassica family, may with advantage be watered with a solution of superphosphate of lime at the rate of one eighth of an ounce in a gallon of water.

Turnips are fit for use in about 3 months—para. 52; swedes take 2 or 3 months longer.

May be sown in the open as early as February.

Usually sown in the open in May with successional sowings to the end of June and also in August if desired.

Sow half an inch deep in drills.

The drills should be 12 inches apart.

Will not stand transplantation—para. 44.

Thin out—para. 43—to a distance of 1 foot between plants for roots of a fair kitchen size; for large roots thin out to a greater distance; in thinning out leave the shortest seedlings; these will develop best.

Must have plenty of water and should be watered freely; the soil should never be allowed to get dry.

When frost sets in should be mulched—para. 50—or may be taken up and after the leaves have been cut off about half an inch above the roots may be stored in sand or under straw in a dry cool place.

HERBS.

Mint: *Mentha Viridis*.

Does well either in a sunny situation or in one partially shaded.

Prefers a moderate loam—para. 8—but the soil must be rich and moist.

Requires some lime—para. 15—but not much.

Farmyard manure—para. 13—if used should be applied liberally.

The mixture of artificial fertilizers recommended in para. 31 for general use is suitable for mint and it may be applied as recommended in para. 35.

Should be watered constantly with a nitrogen fertilizer—para. 35 (5).

Propagated by the planting of root-divisions or by cuttings rooted in a shady situation in a piece of good soil.

Fit for use—para. 52—in about 4 months.

Plant root-divisions in March or April or take cuttings during the summer.

Plant root-divisions or rooted cuttings about 2 inches deep in rows at least 9 inches apart and with a distance of 6 inches between plants.

Water freely in dry weather.

When the flowers first open shoots may be gathered for drying.

In September cut the stems down to the ground and mulch —para. 50—with a fairly thick layer of soil.

In April or May apply good farmyard manure or the mixture of artificial fertilizers recommended in para. 31 for general use.

Lift and replant every 3 or 4 years.

Parsley : *Petroselinum Sativum* (*Carum Petroselinum*).

Best grown in partial shade.

Prefers a good moist loam—para. 8—well-dug and fairly rich ; does not do well in light soil.

Does not require much lime—para. 15—but should have a little.

Soot—para. 26—is useful as it tends to prevent a disease of the roots to which parsley is liable.

Farmyard manure—para. 13—if used should not be applied fresh, but the soil should have the remains—though not too rich—of such manure applied to a crop that has preceded the parsley.

The mixture of artificial fertilizers recommended in para. 31 for general use is suitable for parsley and it may be applied as recommended in para 35.

Should be watered from time to time with a nitrogen fertilizer —para. 35 (5).

Cultivated from seed of which 1 ounce will suffice for a row of 50 feet.

Seed germinates—para. 41—slowly ; germination takes at least a fortnight and may take up to 6 weeks ; it may be hastened by steeping the seed in warm water and then drying it just before it is sown.

Fit for use—para. 52—in about 3½ months ; it may be picked when the plants are about 3 inches high.

Sow in the open at any time from the end of February to the end of July.

Sow 1 inch deep along a border or in a plot ; in a plot the sowing may be either broadcast or preferably in drills.

Drills should be 12 inches apart.

Thin out—para. 43 ; sufficient room to grow is very important ; the leaves of neighbouring plants should not be allowed to meet or touch ; plants with leaves that curl least should be removed in thinning out.

Stands transplantation—para. 44.

When seeds are about to form or when the leaves become coarse cut the stems down to the ground; parsley loses its value when seeds have developed on it.

For winter use, pot a few strong plants and keep these in a moderate temperature constantly watered with a nitrogen fertilizer—para. 35 (5).

Parsley plants may be kept and used for 2 or 3 years, but it is advisable to renew parsley beds every year since the running of parsley to seed in its second season is a constant nuisance.

Sage: *Salvia Officinalis.*

Prefers a sunny situation but does well in partial shade if well protected from cold winds.

Prefers a moderate loam—para. 8—somewhat dry and not very rich.

Requires a little lime—para. 15—but not much.

Farmyard manure—para. 13—if used, should be applied—not too freely—some time before the sage is planted out.

The mixture of artificial fertilizers recommended for general use in para. 31 is suitable for sage and it can be applied as recommended in para. 35.

Requires only an occasional watering with a nitrogen fertilizer—para. 35 (5).

Cultivated either from seed (of which but little would be required in a small garden) or from cuttings.

Fit for use—para. 52—in the year following that in which it is grown from seed or cuttings, since the shoots formed in the first year should be cut back in order to encourage a spreading habit of growth.

Sow seed in April, a quarter of an inch deep, in rows.

Take cuttings in April and June and plant them out in rows, watering them constantly till they are rooted and occasionally giving them a dose of a nitrogen fertilizer—para. 35 (5).

The rows in which seed is sown or cuttings are rooted should be 6 inches apart.

Thin out—para. 43—seedlings to a distance of 6 inches between plants; keep the same distance in planting out cuttings.

Stands transplantation—para. 44.

In dry weather seedlings or rooted cuttings require liberal watering and they benefit by the occasional application of a nitrogen fertilizer—para. 35 (5).

In the late autumn or in the spring seedlings and rooted cuttings should be planted out into their permanent positions.

Plants in their permanent positions should be trimmed every winter and spring by the removal of decayed parts, etc.; not more than once in a year or two they may be given a little dry farmyard manure or a small dose of the general use fertilizer mixture —para. 31.

Sage beds may with advantage be renewed every 4 or 5 years.

Thyme : *Thymus Vulgaris.*

Does best in a warm sunny border.

Prefers a light rich loam—para. 8.

Farmyard manure—para. 13—if used may be applied liberally.

The mixture of artificial fertilizers recommended in para. 31 for general use is suitable for thyme and it may be applied as recommended in para. 35.

Propagated from seed or from root-divisions.

Fit for use—para. 52—in about 4 months.

Seed, of which very little is required for an ordinary border, should be sown in April.

Sow shallow—para. 38.

Root-divisions should also be taken in April.

Seed may be sown or the root-divisions planted out in the border where it is intended that the thyme should have its permanent position.

Thin out—para. 43—seedlings to a distance of 6 inches between plants and keeps the same distance between root-divisions in planting them out.

Stands transplantation—para. 44.

Water in dry weather and treat occasionally with a nitrogen fertilizer—para. 35 (5).

When blossoms appear shoots may be gathered to dry and keep for use when required.

The border may with advantage be replanted every 3 or 4 years.

SMALL FRUITS.

The Common Characteristics of Currants, Gooseberries and Raspberries.

Currants, Gooseberries and Raspberries have certain points in common ; these are dealt with here, while matters peculiar to each of these fruits are dealt with separately below.

All do best in a sunny situation ; they do quite well also in partial shade, though this may to some extent retard their ripening.

They prefer good rich loam—para. 8—but do well on any good garden soil provided that they have some shelter from the North ; except the gooseberry which grows best in dryish places, they require a good deal of moisture and a soil that being moderately heavy retains moisture; but in all cases it is essential that there should be adequate drainage; there must be no water logging at all; small fruit grown in fairly light soil is earlier than that grown in heavier soil, and a lightish soil overlying clay is quite suitable for all the fruits now in question; but clay soils are generally too compact for good root action and must be made as light as is possible.

All want some lime—para. 15—but not much.

All can be propagated from cuttings of young ripe wood taken close to the old wood after the fall of the leaf in the autumn; raspberries are best propagated from suckers or root divisions, in the autumn or spring; root divisions and suckers when available are also used for the propagation of the other fruits. It is advisable occasionally to renew the bushes in a garden, but on the average the productive life of the fruits now in question extends from 7 to 12 years, and in the case of some, particularly currants, it may be much longer.

The small fruit now in question may be planted from November to February; the best time for planting is about December, if a period then occurs when the soil is moist without being sticky.

Farmyard manure—para. 13—is very effective with small fruit, and if used 1 barrowload—i.e., about 1 cwt.—should be applied to every 10 square yards every autumn.

With artificial fertilizers a mixture of 1½ ounces of superphosphate of lime—para. 21—and one ounce of potassium sulphate—para. 23—should in the autumn be dug into each square yard of the ground on which the fruits stand, while in the spring and summer, especially after the fruit has set and as long as it is forming and swelling, waterings should be given with a mixture of half an ounce of superphosphate of lime and one ounce of a nitrogen fertilizer—para. 18—to each gallon of water. These waterings should be repeated weekly till the fruit has ceased to swell and then they should be discontinued.

In pruning all the small fruits now in question the objects to be kept in view should be—

To remove all dead wood;

To remove all weak and feeble growths;

To open the interior of the bushes as freely as possible to the influence of the sun and air, and to remove all growths which intercross or interfere with the open character of the bushes; and

To cut off growths quite cleanly just above an eye, for any part of a growth that is left beyond and above an eye will die off.

In the winter when the bushes are leafless, they should be sprayed thoroughly with some preparation which is effective in keeping them free from moss and in discouraging insect pests.

Black Currant : *Ribes Nigrum.*

Each bush should have a space of 6 feet in every direction.

The fibrous roots underneath the bushes are very close to the surface of the ground and digging or hoeing round the bushes must be very shallow and carefully done, or else serious damage to the roots may be caused by it.

As soon as the crop is over prune away all old growths ; the fruit is borne mainly on shoots of the previous year, though older shoots are also productive ; do not shorten new growths but remove thin and unsatisfactory shoots.

If the shoots spring freely from the roots, black currants may be pruned in the same way as raspberries.

Black currants are liable to what is called "Reversion," by which the leaves instead of being freely notched or serrated, as they should be, become less serrated ; a sign of reversion is the existence of less than six points of serration on a leaf, each of the points being connected by a vein with the centre line of the leaf ; reversion is associated with a diminution of fruiting and there is no cure for it ; branches which show reversion should be cut off, and if the reversion spreads the affected bush should be removed.

Another very serious affection of the Black Currant is known as " Big Bud." A small white mite buries itself in the bud and prevents its proper development, at the same time causing the bud to swell into a circular form instead of assuming the somewhat elongated appearance which is characteristic of healthy buds. Big bud is very destructive, very persistent, and very quick to spread. A remedy that may be tried is the hand picking of all buds that appear to be at all abnormal. It is better to pick off healthy buds that have an abnormal appearance than to leave a single big bud. The hand picking should be commenced as soon as the buds begin to swell and allow signs of big bud to be identified and it should be continued constantly and systematically as long as there is any suspicion of the persistence of big bud. But it is only by long continued and regular attention that any impression on big bud can be made by hand picking, and unless such attention can be given the only remedy for big bud is the removal of infected branches or of the plants themselves.

Currant, Red : *Ribes Rubrum.*

Currant, White : *Ribes Rubrum Album.*

Each bush should have a space of about 6 feet in every direction

Fruit is borne on growths which spring from a base on shoots two or three years old.

During the summer all side shoots should be pinched back to about 4 or 5 leaves from their bases.

As soon as the crop is over cut most of the new shoots back to about 3 inches of their bases, but leave intact new shoots required for new branches; cut back all young lateral shoots to one or two eyes only.

Gooseberry: *Ribes Grossularia.*

Each bush should have a space of about 5 or 6 feet in every direction.

Benefits from lime—para. 15.

Bluish markings on the edges of the leaves are a sign that there is not enough potash—para. 23—in the soil.

As soon as the crop is over cut back all weak growths of the current year to about 3 inches of their bases; fruit each year is produced on growths that spring from the shoots of the preceding year.

In the winter or spring cut back all new growths to about 4 or 6 inches of their bases and remove growth that has been made since the summer pruning; it is advisable to defer this operation till the spring since birds may during the winter destroy many buds.

A convenient form of bush has a number of long stems each with a series along it of fruit-bearing shoots, like the cordon of a fruit tree trained in the cordon form; the stems should form the sides of a cup open in the centre: attention in pruning may with advantage be given to securing this style of bush as it bears better than any other form and is easier to pick when the fruit is ripe.

Raspberry: *Rubus Idaeus.*

Loganberry: *Rubus Loganii.*

Raspberries should be planted in rows with a space of about 5 feet between rows and a distance of about 18 inches between the roots—which are known as stools. Loganberries are usually trained against a wall or other support.

Fruit is produced on shoots or canes which have grown from the stools in the year immediately preceding that of the year of fruiting; as soon as the crop is over cut down to the ground all shoots or canes that have borne fruit and reduce the young shoots or canes to 3 or 4 for each stool.

In November or December shorten the tops of the new canes.

In January or February thin out stools that in the previous pruning have been left with too many canes, cut out weak and short canes, cut off such tops of canes as are weak and sappy, and tie to supports the canes that are intended to bear in the coming season.

With autumn fruiting varieties the old canes must be cut down to the stools in February and the new canes must be thinned out and tied up in the summer.

Constant attention should be given to keeping under control the growth of suckers and these should be thinned out regularly.

Rhubarb : *Rheum Rhaponticum or Hybridum.*

A perpetual yielding variety will, with protection during the winter, give a yield all the year round.

Prefers a sunny situation but does well in partial shade.

Prefers a light soil—para. 8.

Does not require much lime—para. 15.

If farmyard manure is used—para. 13—it should be applied liberally in the autumn.

With artificial fertilizers an appropriate mixture for each square yard is 2 ounces of superphosphate of lime—para. 21—and a quarter of an ounce of potassium sulphate—para. 23—dug in during the winter and followed during the period of active growth by fortnightly waterings with a mixture of half an ounce of superphosphate of lime and half an ounce of potassium sulphate and half an ounce of a nitrogen fertilizer—para. 18—to each gallon of water.

Can be raised from seed sown in the open in March and April (or earlier in heat for planting out in May), but plants raised from seed take 3 or 4 years before they are fit to yield any produce.

Usually propagated by root divisions, each of which has a crown or bud ; these should be planted in November to February, and though they will yield leaves during the following year they should be left undisturbed till their second year.

Plant out in the autumn or in March—preferably in the spring.

Plant with the crown slightly above the surface of the ground.

There should be a distance of 2 feet between plants in every direction.

To force in early spring cover with large inverted pots.

Remove the flower stems as they appear.

Pick leaves with moderation ; too free a picking weakens plants and may result in their destruction.

Lift and divide every four years.

Strawberry : *Fragaria*

Should have a sunny situation but in partial shade does well though the crop is delayed.

Prefers a deep rich sandy loam—para. 8; the soil must be compact and rammed down; in very light soil lasts only a couple of years and in clay will not do at all.

Requires some lime—para. 15—but not much.

While the roots spread a little near the surface, the most important roots go downwards; strawberries therefore benefit most from manure or fertilizers dug in quite close to them.

If farmyard manure is used—para. 13—a liberal application should be made in the autumn and a top dressing given in March.

With artificial fertilizers an appropriate mixture for each square yard is 2 ounces of superphosphate of lime—para. 21—and 1 ounce of potassium sulphate—para. 23—dug in during the winter and followed by weekly waterings with a nitrogen fertilizer—para. 3 (5)—when the flowers form and twice weekly after the fruit has begun to set.

Can be propagated from seed, root divisions, or runners; varieties cannot be depended upon to grow true to name from seed, and the usual method is to use runners which are planted in the autumn and have their flower stems as they appear removed during the next year when they should not be allowed to bear fruit.

Plant out in August.

Plant with a distance of 2 feet between plants in every direction.

In May put straw on the beds in order to protect the berries from dirt.

Runners as they appear should be constantly and regularly removed, except such as may be required for propagation; in strong plants runners are produced with remarkable rapidity but they can be kept down without difficulty if a point is made of pinching off those that are most prominent every time the strawberry bed is visited.

Strawberries want a great deal of water and this should be regularly applied; water must specially be given in dry weather particularly when the fruit is swelling.

As soon as the crop is gathered cut off the old large leaves so as to let the young leaves have light, air and space for development.

If liberal manuring induces very luxurious foliage, in the weekly and bi-weekly waterings with liquid fertilizers a solution similar to that recommended for the watering of rhubarb may be used, and even in this the nitrogen may be reduced or eliminated; otherwise the formation of fruit may be prejudiced.

Beds are usually renewed every 3 or 4 years, but with care and the constant and systematic removal of runners and of old leaves beds will last well for 5 or 6 years.

Separate plants produce male and female flowers respectively and the flowers may be blind unless there is a sufficient mixture of plants of the sexes together.

INDEX

PAGE

ACID—Prevents plants from freely absorbing plant food in soil - 13
  Acid reaction of superphosphate of lime counteracted by lime - - 25
  Acid reaction of superphosphate of lime useful in soil containing excess of lime - - - - 31
  Acid unfavourable to bacterial activity in soil - - - - 13
ADCO—Agent for conversion of refuse into material containing qualities of humus—details regarding - 34
ALKALINE REACTION — in surrounding water necessary to enable plants to absorb food - 24
ARTIFICIAL FERTILIZERS —
  Accurately adapted to requirements of plants - - - 21, 27
  Ascertainment in mixtures of percentages of nitrogen, etc. - - 38
  Depth of digging in - - - - 40
  Economic method of use - - - 22
  Good results from proper use - - 23
  In excess, harmful - - - - 39
  Lime-reduction by, easily remedied 22
  Method of application to growing plants - - - - - - - 43
  Mixtures recommended for different vegetables - - - - - - 39
  Objections against, considered - 21
  Quantity for use in rows or drills - 40
  Quantity for use with different vegetables in each square yard - 41
  Reaction between certain, and lime 25
  Reaction on each other and precautions in mixing - - - 27
  Rigid adherence to dates of application not essential - - - 23
  Routine for annual digging in - 42
  Routine for applying nitrogen fertilizers - - - - - - 43
  Solution of, 1 gallon sufficient for one square yard - - - - 41
  Solution of strength recommended, effective economical and harmless to seedlings or leaves - - 45
  Solution of, stronger than sap, harmful - - - - - - 44
  Solution of, weak, more readily absorbed by plants - - - 45
  Unless in dilute solution burn leaves of plants - - - - - 26

PAGE

  Weightment necessary of ingredients in mixtures - - - - - 39
  Weightment may, in absence of scales, be estimated by teaspoonfuls - - - - - - - 40

BACTERIAL ACTIVITY — Acid unfavourable to - - - - 13
  Essential for plant life - - - 13
  Humus good medium for - - 13
  Impeded by cold of English Winter 27
  Phosphate beneficial for - - - 30
  Principal agency for supply of nitrogen for plants - - - 28
  Requires lime - - - - 13, 24
BASIC SLAG—Application of - - 31
  Compared with superphosphate of lime - - - - - - - 31
  Does not contain lime - - - 31
  Phosphate percentage in - - - 31
BEETROOT—Cultural notes on - 58
BRASSICA FAMILY—Cultural notes on - - - - - - - - 59
BROAD BEANS—Cultural notes on 61
BROCCOLI—Cultural notes on - - 62
BRUSSELS SPROUTS—Cultural notes on - - - - - - - 63
BURNING GARDEN REFUSE—Less profitable than use of refuse as a basis for humus - - - 33

CABBAGES—Cultural notes on - 63
CALCAREOUS SOIL - - - - 12
CAPILLARY ACTION Described - 12
  Beneficial for seedlings - - - 46
  Quantity of water lost by - - 53
CARROTS—Cultural notes on - - 64
CAULIFLOWERS—Cultural notes on 65
CELERY—Cultural notes on - - 66
CHALK SOIL - - - - 12
CLAY SOIL - - - - - - - 11
CULTIVATION—Summary of points essential for good - - - - 55
CULTURAL NOTES—List of, on herbs - - - - - - - 57
  List of, on small fruits - - - 57
  List of, on vegetables - - - 56
CURRANTS—Black, Cultural notes on - - - - - - - - 89
  Red—Cultural notes on - - - 89
  White—Cultural notes on - - 89

PAGE

DIGGING—Depth of, for artificial fertilizers - - - - - 40
  Necessity for - - - - - 46
  When best done - - - - - 46
DRAINAGE—Suggested methods of 16
DRILLS—Better than broadcasting for vegetable cultivation - - 53
  Distance between, to facilitate hoeing - - - - - - - 53
  Preparation of, for sowing - - 46
  Should run north and south to get full effect of sun - - - - 11
  Quantity of artificial fertilizers to be applied in - - - - - 40

FARM-YARD MANURE—Agency for renovating humus - 14, 20, 32
  Amount and time of application - 20
  Not indispensable - - - - 20
FIRMNESS OF SOIL—Advantages of - - - - - - - 51
  Capillary action increased by - - 46
  Necessary in transplantation - - 51
FRENCH BEANS—Cultural notes on 68

GERMINATION—Heat necessary for 47
  Heat 50° F., sufficient for - - 48
  Moisture essential for - - - 49
  Period of - - - - - - 48
GOOSEBERRIES—Cultural notes on 90

HERBS—List of, for which cultural notes are given - - - - 57
HOEING—Uses of - - - - 52
  With established plants required as check on evaporation - - - 52
HUMUS—Character of - - - 13
  Constantly exhausted and must be constantly renewed - - - 22
  Farm-yard manure used for renovating supply of - - 14, 20, 32
  Must be neutralized by lime - - 13
  Obtainable from garden and other refuse - - - - - - 33
  Owes its richness to bacterial activity - - - - - - 13
  Readily obtained from refuse by use of Adco - - - - - 34
  Routine measures necessary for annual renovation of - - - 42
  Special measures, e.g., use of shoddy may be necessary for renovation of - - - - - - - 34
  Vital importance of - - 13, 20, 32, 42

JERUSALEM ARTICHOKES—Cultural notes on - - - - 70

KAINIT—Use of, as a potash fertilizer - - - - - - - 32
KALE—Cultural notes on - - - 71

PAGE

LEEKS—Cultural notes on - - 72
LETTUCE—Cultural notes on - - 73
LIGHT—Its effects on plants - - 11
  Seedlings want protection from strong - - - - - - 49
LIME—Best form for garden application - - - - - - 26
  Best time for garden application - 25
  Can be mixed with salt for use - 35
  Characteristics of - - - - 24
  Constant loss from soil and need for constant renewal - - - - 25
  Counteracts acid reaction of superphosphate of lime - - - - 25
  Deficiency of, indicated by free growth of certain plants - - 24
  Essential for healthy growth of plants - - - - - - 24
  Method of application to growing plants - - - - - - 43
  Must be used some time before certain artificial fertilizers - - 25
  Must be used with sulphate of ammonia - - - - 25, 28
  Must be used with sulphate of potassium - - - - 25, 32
  Not contained in superphosphate of lime or in basic slag - - - 31
  Presence of, indicated by the free growth of certain plants - - 24
  Promotes bacterial activity - 13, 24
  Quantity of, for average annual application - - - - - 24
  Quantity for different vegetables in each square yard - - - - 41
  Routine for annual digging in - - 42
  Should be applied as long as possible before required by plants for use 26
  Supply of, drawn on by artificial fertilizers can be made good without ill effects on soil - - 22
LOAM - - - - - - - - 14
LOGANBERRIES—Cultural notes on 90

MARL - - - - - - - - 14
MATURITY—Period for different vegetables between sowing and fitness for use - - - - - 53
MINT—Cultural notes on - - - 84
MOISTURE—Amount required by plants during life - - - - 15
  Osmosis - - - - - - 44
  Soil must be moderately retentive of 14
  Subsoil must not be too retentive of 15
  Stagnant round roots, effect of 12, 14
MULCHING—Benefits seedlings - 46
  Method when used as protection against frost - - - - - 47
  Prevents loss of water by evaporation - - - - - - 46
  Process of - - - - - - 53
  Retains heat in soil - - - - 47

PAGE
NITRATE—Form in which plants use nitrogen 28
  Produced by bacterial activity 27
NITRATE OF SODA—Character of 28
  Compared with sulphate of ammonia 28
  Nitrogen percentage in good sample 29
  Method, quantity and time of use 28
  Precautions necessary in using 28
  Teaspoonful of, weight of an average 40
NITROGEN—Ascertainment of percentage of, in a mixture of artificial fertilizers 38
  Easily washed out of soil 27
  Effects on plants 27
  Form in which used by plants 28
  Form and strength of applications recommended 29
  Good vehicles for application of 28
  Result of excessive application 28
  Requirements of different vegetables for 29
  Routine for application of 43
  Should not be used alone 27
  Time best for application 27
  Warning given by plants when they have had enough 30
  When to cease application 28

ONIONS—Cultural notes on 74
OSMOSIS 44

PARSLEY—Cultural notes on 85
PARSNIPS—Cultural notes on 75
PEAS—Cultural notes on 76
PEAT 13
PHOSPHATE—Application in the form of basic slag 31
  Application in the form of superphosphate of lime 30
  Ascertainment of percentage of, in mixture of artificial fertilizers 38
  Effects of, on plants 30
  Not easily washed out of the soil 30
  Routine for annual application of 42
PLANT FOOD—How absorbed by plants 43
  Must be constantly renewed in soil 19
POTASH—Application of in the form of Kainit 32
  Application of in the form of sulphate of potassium 32
  Ascertainment of percentage of, in mixture of artificial fertilizers 38
  Effects of, on plants 31
  Not easily washed out of the soil 31
  Routine for annual application of 42
POTATOES—Cultural notes on 78
POULTRY DUNG—Character of 36
  Method in which can be used best 36
  Should not be used alone 36

PAGE
RASPBERRIES—Cultural notes on 90
REFUSE—Should not be burned but used as a basis for humus 33
RHUBARB—Cultural notes on 91
ROTATION—Importance of 17
  Suggested for vegetables 18
ROWS—See Drills.

SAGE—Cultural notes on 86
SALT—Can be mixed with lime for use 35
  Method of application to growing plants 43
  Quantity of, for average annual application 35
  Quantity of, for different vegetables in each square yard 41
  Reaction with certain artificial fertilizers 35
  Routine for annual digging in 42
  Use of 35
SAND 12
SCARLET RUNNER—Cultural notes on 68
SEED-BEDS—Preparation of 46
SEEDLINGS—Firm soil necessary for 46, 51
  Frost, want protection from 49
  Of non-transplantable vegetables of no further use when removed in thinning out 50
  Of transplantable vegetables removed in thinning out may be replanted 50
  Moisture required by 49
  Mulching benefits 46
  Soil disturbed in thinning out should be made firm and even 50
  Sunlight, want protection from strong 49
  Stages at which to transplant 52
  Thinning out imperative 47, 49
SMALL FRUIT—List of, for which cultural notes are given 57
SOIL—Advantage of firmness in 51
  Characteristics affecting capacity to retain sun's heat 11
  Extreme types of 11
  Improvement by mixture of kinds 14
  Must be loosened by digging 46
  Routine for annual renewal of humus and plant food in 42
SOOT—Character and use of 36
SOWING—Amount of seed required 47
  Depth of sowing 47
  Time of, for different vegetables 47
  Time varies according to weather conditions 48
SPINACH—Cultural notes on 81
STRAWBERRIES—Cultural notes on 91
SUBSOIL—Drainage essential 15
  Methods of drainage suggested 16

PAGE
SULPHATE OF AMMONIA—Advantages of using - - - - - 26
Compared with nitrate of soda - 28
Good vehicle for the application of nitrogen - - - - - - - 28
Lime reduction by, easily remedied 22
Liming necessary, if used - 25, 28
Nitrogen percentage of, in a good sample - - - - - - 29, 38
Method, quantity and time best for use - - - - - - - - 29
Quantity recommended in mixtures of artificial fertilizers for different vegetables - - - - - - 39
Teaspoonful of, weight of an average 40
SULPHATE OF IRON—Character and use of - - - - - - 36
SULPHATE OF POTASSIUM—Advantages of using - - - 26
Character and use of - - - 32
Lime reduction by, easily remedied 22
Liming necessary, if used - - 25, 32
Potash percentage of, in a good sample - - - - - - 32, 38
Quantity recommended in mixtures of artificial fertilizers for different vegetables - - - - - - 39
Quantity required for different vegetables in each square yard - 41
Reaction with salt - - - - 35
Routine for annual application - 42
Teaspoonful of, weight of an average - - - - - - 40
SUN—Aspects in England most favourable for - - - - - 11
Seedlings require protection from strong sunlight - - - - 49
Soils most receptive of heat from - 11
Vital importance of sunlight for plants - - - - - - 11
SUPERPHOSPHATE OF LIME—Acid reaction of, counteracted by lime - - - - - - - 25
Advantages in use of - - 26
Best time for applying - - - 31
Character and use of - - - - 30
Compared with basic slag - - - 31
Contains no lime - - - - 31
Liming necessary, if used - 25
PAGE
Quantity recommended in mixtures of artificial fertilizers for different vegetables in each square yard - 41
Reaction with salt - - - - 35
Routine for annual application of - 42
Soluble phosphate percentage of, in a good sample - - - 31, 38
Teaspoonful of, weight of an average - - - - - - - 40
SWEDES—Cultural notes on - - 83

TEA-SPOON—Standard may be used for estimating weights of artificial fertilizers - - - - - - 40
Weight of standard teaspoonful of superphosphate of lime, sulphate of ammonia, nitrate of soda, and sulphate of potassium - - - 40
THINNING OUT—Drastic, necessary for seedlings - - - - 47, 49
Soil disturbed in, must be made firm again - - - - - - 50
Time for effecting - - - - 49
THYME—Cultural notes on - - 87
TOMATOES—Cultural notes on - 82
TRANSPLANTATION—Effect of, on different vegetables - - - 50
Method of and care in - - - 51
Soil for, must be firm - - - 51
Watering required after - - - 52
When to be effected - - - - 52
TURNIPS—Cultural notes on - - 83

VEGETABLES—List of, for which cultural notes are given - - 56
Varieties should be selected from experience or from a good catalogue - - - - - - 56

WATER—Large proportion in composition of plants and large consumption by plants - - - 15
Required by plants after transplantation - - - - - - 52
Quantity lost by capillary action - 53
WOOD ASHES—Character and use of - - - - - - - - 36
Routine for annual digging in when necessary - - - - - 42

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